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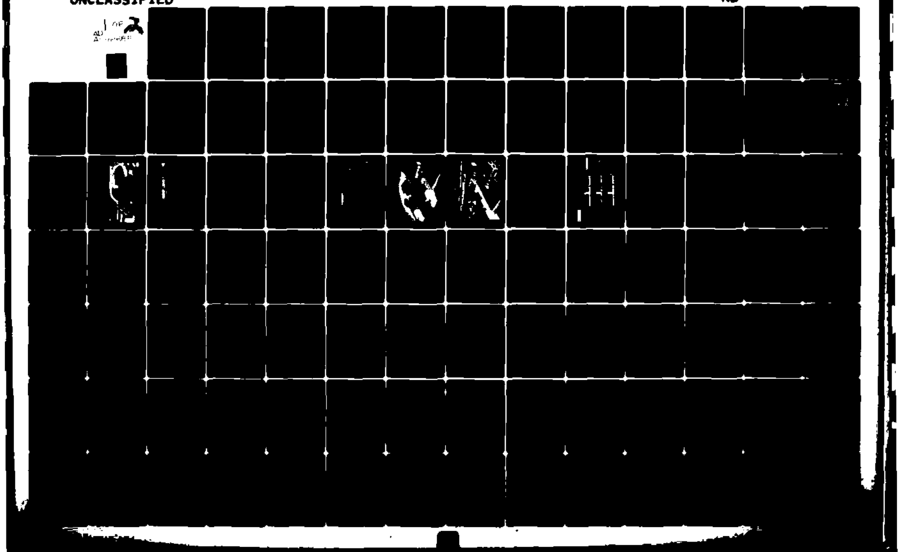

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TECHNOLOGY ASSESSMENT OF THE DACS/MERADCOM PRESTAGED AMMUNITION LOADING SYSTEM (PALS) CONCEPT STUDY

report to

US ARMY MOBILITY EQUIPMENT RESEARCH AND DEVELOPMENT COMMAND

CONTRACT NO. DAAK-79-D-0036 (70)

ORDER NO. 00012

AUGUST 1980

Arthur D. Little, Inc.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Review and critique of existing documentation on the two proposed PALS concepts: The PALS low lift truck and platform concept and the ATS (cable bed transfer vehicle and dock-mounted roller mat container loader) concept, with the baseline system, namely, the existing approved wooden dunnage system. The study concluded that the ATS concept is both cost effective and in commercial use on a daily basis exhibiting acceptable RAM characteristics.

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TECHNOLOGY ASSESSMENT OF THE

DACS/MERADCOM PRESTAGED

AMMUNITION LOADING SYSTEM (PALS)

CONCEPT STUDY

Report to

US Army Mobility Equipment Research
and Development Command

Contract No. DAAK-79-D-0036

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August 1980

Arthur D Little, Inc.

FOREWORD

This document summarizes findings and presents the background material relevant to the study entitled, "Technology Assessment of the DACS/MERADCOM Prestaged Ammunition Loading (PALS) Concept Study". The report presents a systems analysis approach and evaluation of:

(1) Review and critique of existing documentation on the two proposed PALS concepts –

(a) The PALS low lift truck and platform concept,

(b) The ATS (cable bed transfer vehicle and dock-mounted roller mat container loader) concept

with the baseline system, namely, the existing approved wooden dunnage system;

(2) Identify voids, questionable analytical techniques or methodologies;

(3) Visit to Defense Ammunition Center School (DACS) at the Savanna Army Depot, Illinois, and witness outloading ammunition using the wooden dunnage system, AND

(4) Visit to Automatic Truckloading Systems, Inc., Carlisle, Pennsylvania, and Abbott Laboratories, Waukegan, Illinois, to witness the dock-mounted roller bed loader and the cable bed conveyor system for trucks.

The study concluded that of the two concepts compared with baseline wooden system for outloading ammunition in commercial ISO containers the prestaged platform concept is not cost effective compared with the baseline system. The ATS concept is both cost effective and in commercial use on a daily basis exhibiting acceptable RAM characteristics. The ATS concept reduces manpower requirements significantly in the three cycles it affects from 38 to 11 persons per shift. Other PALS improvements, not necessarily related to the ATS concept, offer additional significant savings through improved material handling in the igloo cycle and cost savings through improved materials and productivity in the dunnage cycle.

The potential benefit of PALS improvement, not necessarily associated with ATS affected cycles, would be:

- Improved material handling in the igloo cycle - $345.60 per container,
- Improved dunnage cycle - $384.00 per container, and
- Improved ATS cycles - $398.80 per container.
- Total - $1,128.40 per container.

This report is submitted to the US Army Mobility Equipment Research and Development Command (MERADCOM) Fort Belvoir, Virginia 22060 by Arthur D. Little, Inc., 20 Acorn Park, Cambridge, Massachusetts 02140, and was prepared under Task Order No. 00012 of Contract No. DAAK-79-D-0036. This report was prepared under the guidance of Messrs. Rudolph Messerschmidt Eugene J. Roderick, Norman H. Ferttman, Paul Hopler as the technical points of contact, and Messrs. Jerry Dean and Leon Medler as the COTR's of MERADCOM. Questions of a technical nature should be addressed to Robert H. Bode, 617-864-5770, the Manager of the study and principal investigator; the other investigators included John S. Howland and Dr. Gordon Raisbeck.

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1.0 SUMMARY

1.1 INTRODUCTION

This report presents the results of a system analysis and technology assessment of the DACS/MERADCOM Prestaged Ammunition Loading System (PALS) Concept Study. This concept study encompassed two new ammunition out-loading systems. The first of these is the powered low-lift truck and platform concept. For this system the prestaged load is stored on platforms in the igloo for readiness. The other system considered in this PALS concept study is the automatic truck loading system (ATS) which utilizes cable bed transfer vehicles and a dock-mounted container loader to accomplish the PALS mission, namely, rapid turnaround of containers at the CONUS depots during contingency/mobilization conditions. In this ATS system the ammunition in the igloo is not prestaged; it is stored in the conventional manner as it is in the baseline wooden dunnage system.

The DACS/MERADCOM concept study included an operational and cost effectiveness evaluation of these two new systems in comparison with the baseline system.

1.2 BACKGROUND

In the Program Management Plan for Containerized Ammunition Distribution System Development (Conventional Munitions), a report by the Director for Transportation and Warehousing Policy, Office of the Assistant Secretary of Defense Manpower, Reserve Affairs and Logistics (MRA&L) dated (Jan 80-Rev), in Section 1, Introduction, 1.1 Background, "DOD planning for and shipment of conventional ammunition depends extensively on the use of commercial US Flag ships (i.e., containerships, RO-RO, SEABEE, LASH). By 1985, approximately 55% of the US Flag ships may be container capable ships with non-self-sustaining containerships comprising the majority of available shipping. Any future contingency operations of any magnitude or duration will require reliance on commercial containers and containerships. Since ammunition may account for 35 - 40% of the total tonnage, DOD must adapt its logistical distribution system to delivery of containerized ammunition from source to user.

"This program integrates the efforts of the separate services to prevent duplication, assess timely progress and assure compatibility in the evolving system. This document reports progress and plans to all concerned. The Joint Intermodal Steering Group (JISG) provides guidance, resolves differences and directs corrective actions."

Section 1 in its entirety is presented in Appendix A.

In support of this program management plan, an LOA for a Prestaged Ammunition Loading System (PALS) has been forwarded to TRADOC as a DARCOM approved requirement. Under item 3, System Description, "a. The PALS design goal is to reduce the time of commercial container turnaround at the ammunition depot." The Operational Concept, item 2, a., of the LOA states, "The PALS will be employed in a role similar to the current system for restraining ammunition in commercial 20-foot cargo containers. Ammunition will be pre-secured to the system and rapidly inserted and secured in the container at the ammunition depot. The container, with its secured cargo, will then move through the supply distribution system as any other containerized load. At the far shore distribution point, the ammunition will be removed by conventional MHE and the PALS will be returned to CONUS as retrograde cargo."

The other, more important, characteristic of PALS is stated in item 3, System Description of the LOA,"c. The PALS should consist of a simple device on which the ammunition load is assembled and secured. The load must be consolidated into a controllable mass. Simple means must be provided for container loading and for securing the device inside the container when the empty container arrives at the depot. PALS must provide the restraint necessary to meet the Association of American Railroads (AAR) and Coast

Guard (CG) regulations for the shipment of ammunition. The system must be compatible with existing MHE in the retail system. Any modification, alterations or adjustments to wholesale MHE must be minimized."

The concept embodiment of PALS was the powered low-lift truck and platform. It was recognized in the LOA that the platform system may not be as cost effective as desired in comparison with the baseline restraint system. Reference is made to item 4., Prospective Operational Effective-ess and Cost, "b. Although the PALS is expected to cost more than the two existing restraint systems, its effectiveness in the early stages of a contingency makes this cost differential acceptable." The LOA is included as Appendix B.

Then a joint working group (JWG) meeting was held on 12-13 March 1980 at the US Army Defense Ammunition Center & School (USADACS) to evaluate and select for development a prestaged ammunition loading system (PALS). This critique included proponents of the prestaged platform system, namely, representatives from Brooks & Perkins, Inc., and it included proponents of an alternative new container loading concept which, through advanced mechanization, resulted in the same PALS design goal, namely, to reduce the turn-around time of commercial container at the ammunition depot without the requirement of prior prestaging of the ammunition loads on platforms in the igloos for readiness. The proponent of this latter concept, the dock-mounted container loader concept or "ATS" system, was a representative from Automatic Truckloading Systems, Inc.

The conclusion of this technical meeting was:

"1. The working group agreed that a continuing effort on both the Prestaged Platform Concept and the Dock-mounted Container Loading System (ATS) is encouraged.

"2. It was also concluded that the PALS platform concept should be considered as a viable method for rapidly deploying ammunition during the early stages of mobilization provided a satisfactory handling capacity is available to field forces."

The recommendations were:

"1. The PALS JWG concluded the meeting with two recommendations:

a. First, that the PALS-Automatic Container Loader Concept (ATS) be expeditiously developed and tested (6.3) for rapidly outloading ammunition in 20 ft freight containers at CONUS depot, plant and port facilities in a timeframe consistent with DARCOM mobilization planning.

b. Second, that a new PALS LOA be prepared to include rapid deployment of prestaged ammunition loads in the earliest stages of mobilizing contingency forces."

The minutes and log of attendees of this technical meeting are presented as Appendix C.

With this background in mind, Arthur D. Little undertook the study to evaluate the two new PALS concepts in comparison with the baseline system, namely, the wooden dunnage system which is the current approved system for outloading ammunition in leased commercial containers. The basic PALS requirement is to outload 100 containers per depot, per day for a minimum period of 25 days, or the outloading of a total of 2,500 containers.

1.3 OBJECTIVE

The objective of the task is to conduct an analysis of work accomplished jointly by USADACS and MERADCOM for improving turnaround time of commercial freight containers being outloaded with conventional military explosives at CONUS depots during contingency/mobilization conditions.

The system analysis and technical assessment were directed to evaluate independently the cost and readiness effectiveness of the two PALS concepts as compared with the baseline system.

1.4 SCOPE OF WORK

The scope of work is limited to performing a technical assessment of PALS concept formulation and feasibility investigation conducted by DACS/MERADCOM and analysis of supporting data, namely, the comparison of the proposed Powered Low-Lift Truck and Platform Concept (the original PALS concept) and the proposed ATS (cable bed transfer vehicle and dock-mounted roller mat container loader) concept with the present baseline wooden dunnage system.

The criteria for the determination of effectiveness included the following must items. Either of the proposed systems must:

1. Not require container modification for outloading ammunition.

2. Be cost effective when measured against the current baseline system.

3. Provide equal or improved explosive safety while handling ammunition in the depot area and transporting it in Interstate Commerce.

4. Be compatible with existing materials handling equipment in the field (TO&E).

5. Not adversely impact the container unloading in the field.

The study was conducted in seven subtasks as follows:

Subtask 1. Review and critique existing documentation on the two proposed PALS concepts.

Subtask 2. Identify voids, questionable analytical techniques or methodologies.

Subtask 3. Visit the Defense Ammunition Center and School at the Savanna Army Depot, IL., and witness outloading ammunition using the wooden dunnage system.

Subtask 4. Visit ATS, Inc., Carlisle, Pennsylvania and/or Abbott Labs, Waukegan, IL., and witness operation of the automatic truck loading system.

Subtask 5. Evaluate data and develop findings.

Subtask 6. Write and submit draft final report with recommendations.

Subtask 7. Meet at MERADCOM to discuss government comments and finalize report.

1.5 FINDINGS

1.5.1 Results of Subtask 1 - Review and Critique of Existing Documentation on the Two Proposed PALS Concepts and Compare these Concepts with the Baseline Systems, namely, the Existing Approved Wooden Dunnage System

1.5.1.1 The PALS low-lift truck and platform concept is not cost effective when compared with the baseline wooden system. There are two major cost items that are the basis of the defeat of the platform system. These are the $2,416,000 average investment for igloo modifications and the second is the high cost of dunnage materials, namely, the $5,577,000 which includes the cost for platforms. (For discussion see section 2.6.)

1.5.1.2 The ATS (cable bed transfer vehicle and dock-mounted roller mat container loader) concept is cost effective with the present baseline wooden dunnage system on the basis of the DACS/MERADCOM analysis which assumed a total investment for each of the two systems. If, however, any ammunition depot is partially equipped with as much as 68% of the total investment required for the baseline wooden system, and not partially equipped for the ATS system, the ATS system would be at a break-even with the baseline system.

1.5.2 Results of Subtask 2 - Identify Voids, Questionable Analytical Techniques or Methodologies

1.5.2.1 The validity of the igloo cycle for the ATS system versus the baseline system is questioned. The savings projected to the ATS system could be made available to the baseline system if the proposed forklift material handling practices were also adapted to the baseline system.

1.5.2.2 The comparison of the dunnage cycle of the ATS system with the baseline wooden dunnage system was also questioned. Applicable changes from improved dunnage materials and improved installation procedures in the future should be applicable to both systems.

1.5.2.3 The need for redundancy with the ATS system was also questioned because of the single links in the ATS system without backup. The first of these is the dependence upon one dock-mounted loader which is required to load a container every 10 minutes per 20 hour day. The estimated minimum cycle time of the roller mat loader during the stuffing operation is two and one half minutes and does not include the lateral transfer operation to align the loader with the container and then return to the prestaging conveyor and the transfer subcycle of moving the load from the prestaging conveyor to the roller mat loader. The second single link with the ATS system is the dependence upon one rubber-tired container handler for the bottom inspection and transfer of empty containers to the pad location and transfer of full containers from the outloading pad location to the flat car. Availability of either of these single links is critical to the container turnaround rate.

1.5.3 Results of Subtask 3 - Visit to Defense Ammunition Center School at Savanna Army Depot

1.5.3.1 The witnessing of outloading ammunition using the wooden dunnage system in commercial ISO containers verified the high labor intensity required for stuffing of ammunition utilizing the baseline system. The stuffing of a single container with 155 mm ammunition required approximately one and one half hours for a crew of three.

1.5.3.2 The time study performed at Milan Ammunition Depot confirmed the estimates for the labor costs on the DACS/MERADCOM study for the baseline system. The projected labor costs for outloading 100 containers utilzing the wooden dunnage system and utilizing the Milan time study indicated a cost of $4,050,000 on the basis of 162 persons working per shift for two shifts for 25 days. This Milan study compared with the DACS/MERADCOM estimated labor cost for the baseline wooden system of $4,062,000.

1.5.3.3 The dunnage prefabrication operation at Savanna to have a capability of producing dunnage for 100 containers per day indicated the need of doubling the existing dunnage preparation space. Thus, it would appear that over 4,000 square feet of dunnage shop will be required with machines and material flow organized to permit the smooth flow of material and provide the working space needed for a crew of up to 65 persons per shift.

1.5.4 Results of Subtask 4 - Visit to ATS, Inc., Carlisle, Pennsylvania and/or Abbott Laboratories, Waukegan, Illinois, and Witness the Operation of the Automatic Truckloading System

Based upon the observation of the loading cycle time of the ATS roller bed dock-mounted loader and the unloading cycle time for the cable bed transfer truck, we estimate the following load cycle times for the ATS ammunition loading subsystems:

- ATS roller bed container loading subsystem - 2.5 minutes
- ATS cable bed transfer truck unloading subsystem - 1.5 minutes

1.5.4.1 The RAM characteristics of the ATS subsystem, both the dock-mounted loader and the cable bed conveyor, are very good based upon user* comments.

1.5.4.2 The ATS subsystems are commercially operating.

- The roller bed truck loading system is principally in prototype form (only four have been build and the design is still evolving).
- The cable bed truck system is in production form (hundreds are in use).

1.5.5 Results of Subtask 5 - Evaluate Data and Develop Findings

The findings concerning criteria are as follows:

- The ATS system does not require container modification for outloading ammunition.
- The ATS system is cost effective when measured against the current baseline system; the saving is approximately $398.80 per container excluding any cost benefits in the igloo and dunnage cycles. These latter benefits were believed potentially attainable for both the baseline system and the ATS system by Arthur D. Little.
- Following a reevaluation of the igloo cycle, the potential cost benefits of the improved cycle will reduce the manpower requirement from 12 to 4 per shift and a corresponding reduction in forklift trucks. The resulting saving for either the ATS or baseline system would be $345.60 per container.

*The two users were Abbott Laboratories, Waukegan, Illinois for the dock-mounted loader and Dolphin Distribution Services, an exclusive warehouse for Hershey Chocolate Products, near Hershey, Pennsylvania.

- If the ATS compatible dunnage can be developed and the material and productivity saving is applicable to both the ATS and baseline systems, the resulting saving for either system would be $384.00 per container.
- The ATS system will provide improved explosive safety while handling ammunition in the depot area since it is less labor intensive.
- The ATS system is compatible with existing field materials handling equipment and will not adversely impact container unloading in the field.

1.6 CONCLUSION

Of the two concepts compared with the baseline system for outloading ammunition, the prestaged platform concept is not cost effective compared with the baseline system. The ATS concept is both cost effective and in commercial use on a daily basis exhibiting very good RAM characteristics. The ATS concept reduces manpower requirements significantly in the three cycles it affects, a reduction from 38 to 11 persons per shift.

The potential benefit of PALS improvement to either system--ATS or the improved wooden dunnage baseline would be:

Improved Igloo Cycle	$345.60 per container
Improved Dunnage Cycle	$384.00 per container

The added potential benefit of ATS:

Improved ATS Cycles	$398.80 per container

Hence with these benefits the expected future costs for the ATS vs. the baseline system would be:

Cycle	Costs/Container Improved Baseline	ATS
Igloo	$ 72.00	$ 72.00
Intra Depot Transport	156.00	210.00
Container Loading	664.80	286.80
Full Container Handling	149.60	74.80
Dunnage	676.00	676.00
Total	$1,718.40	$1,319.60
Saving		$ 398.80

1.7 RECOMMENDATIONS

- Develop and test an ATS compatible dunnage system.
- Develop and test the ATS ammunition outloading concept.
- Determine the RAM characteristics of the ATS concept and determine the redundancy that will be required, namely,
  - The need for a second dock-mounted container loader;
  - the need for a second 50,000 pound rubber-tired container handler.
- Reevaluate the igloo cycle. Based upon the findings for the cost benefits of the improved cycle, implement the improved cycle for either the baseline system or the ATS system.
- Develop a simulation model that is adaptable to any of the 15 ammunition outloading depots for the planning of an optimum outloading system configuration utilizing PALS equipment and manpower to outload 100 containers per day for 25 days at each depot.

2.0 REVIEW AND CRITIQUE EXISTING DOCUMENTATION ON THE TWO PROPOSED PALS CONCEPTS AND COMPARE THESE CONCEPTS WITH THE BASELINE SYSTEMS, NAMELY, THE EXISTING APPROVED WOODEN DUNNAGE SYSTEM (SUBTASK 1)

2.1 AMMUNITION OUTLOADING REQUIREMENT

DARCOM magazine storage is located at 12 Army ammunition depots and three ex-Navy NAVORD facilities. These storage facilities are summarized in Appendix D. From any one of these depots, the requirement is to outload a minimum of 100, 20 foot commercial ISO containers per day for 25 days during mobilization or contingency operation. For the purposes of this study, a day* has been assumed to be a 20-hour day and the 20-hour day has been interpreted as consisting of 20, 50-minute hours, for a productive time of 1,000 minutes. Hence the cycle time for outloading a container has to be less than 10 minutes to support a sustained average of 100 containers in a 1,000 minute working day.

2.2 METHOD OF ANALYSIS

The comparative cost analyses for each of the systems that were prepared by DACS/MERADCOM are presented in Appendix E. The summary portion of these cost analyses is presented in Figures 1, 2, and 3. Backup support costs for the summary analyses are presented in Figures 4 through 8 of the same Appendix. For the Arthur D. Little review and critique of the existing documentation on the two proposed PALS concepts, we divided the total outbound operation into specific cycles for analysis purposes. These cycles were defined as follows:

Igloo Cycle - Ammunition handling from storage in igloo to depot transport vehicle or platform.

Intra Depot Transport Cycle - Transport from igloo location to container stuffing location (PAD)

*DACS has pointed out a 20-hour day is an interim condition during mobilization; the objective will be to go to a three-shift, 24-hour day as soon as possible.

Container Loading Cycle - Ammunition handling from depot transport vehicle into the container.

Loaded Container Handling Cycle - Container handling from stuffing location to rail car (TOFC/COFC)*.

Dunnage Cycle - Dunnage shop to stuffing dock and including installation in container.

This cycle allotment of equipment cost and labor or manpower cost delineated the significant differences between the alternative new systems as compared with the approved baseline system.

2.3 PALS POWERED LOW-LIFT TRUCK AND PLATFORM CONCEPT

This platform system is presented in schematic form in Figure 2-3-1. It involves principally an igloo cycle which moves the prestaged ammunition load that is restrained on a platform from storage in the igloo by a platform truck manufactured by Baker Materials Handling Corp.; the truck is Model PAL-W-DD (Dual Drive); it has a capacity of 20,000 pounds at 54-inch load centers; it is battery operated and has SCR controls. The battery powered truck is presented in Figure 2-3-2. Each igloo has a large loading dock in the shape of a right triangle, the hypotenuse of of which is the width of the igloo. Four containers are staged around the dock, and the igloo cycle includes the stuffing of the container. Hence the third cycle, as a separate entity, is completely eliminated.

A 50K pound rubber-tired container handler (RTCH) moves the full containers to the transporter at the igloo. The full containers are then transported by an M871 transporter to the railroad siding. Then a second 50K RTCH transfers the loaded containers from the transporter at the railroad siding to the rail car. Dunnage and batteries are transported from

*Trailer on Flatcar/Container on Flatcar

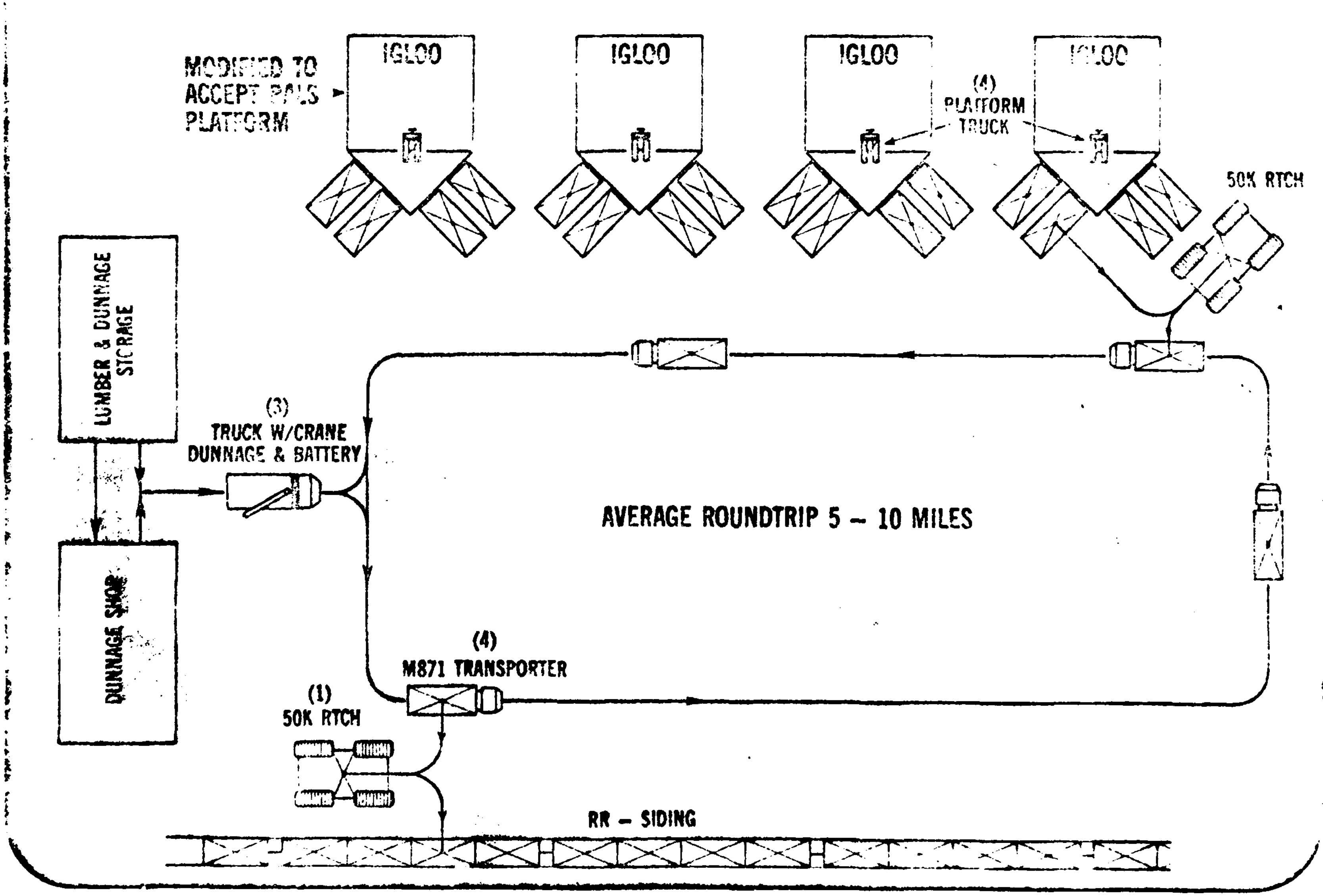

IGLOO
IGLOO
IGLOO
IGLOO
MODIFIED TO
ACCEPT PALS
PLATFORM
(4)
PLATFORM
TRUCK
50K RTCH
LUMBER & DUNNAGE
STORAGE
(3)
TRUCK W/CRANE
DUNNAGE & BATTERY
AVERAGE ROUNDTRIP 5 – 10 MILES
DUNNAGE SHOP
(4)
M871 TRANSPORTER
(1)
50K RTCH
RR – SIDING

Figure 2-3-1

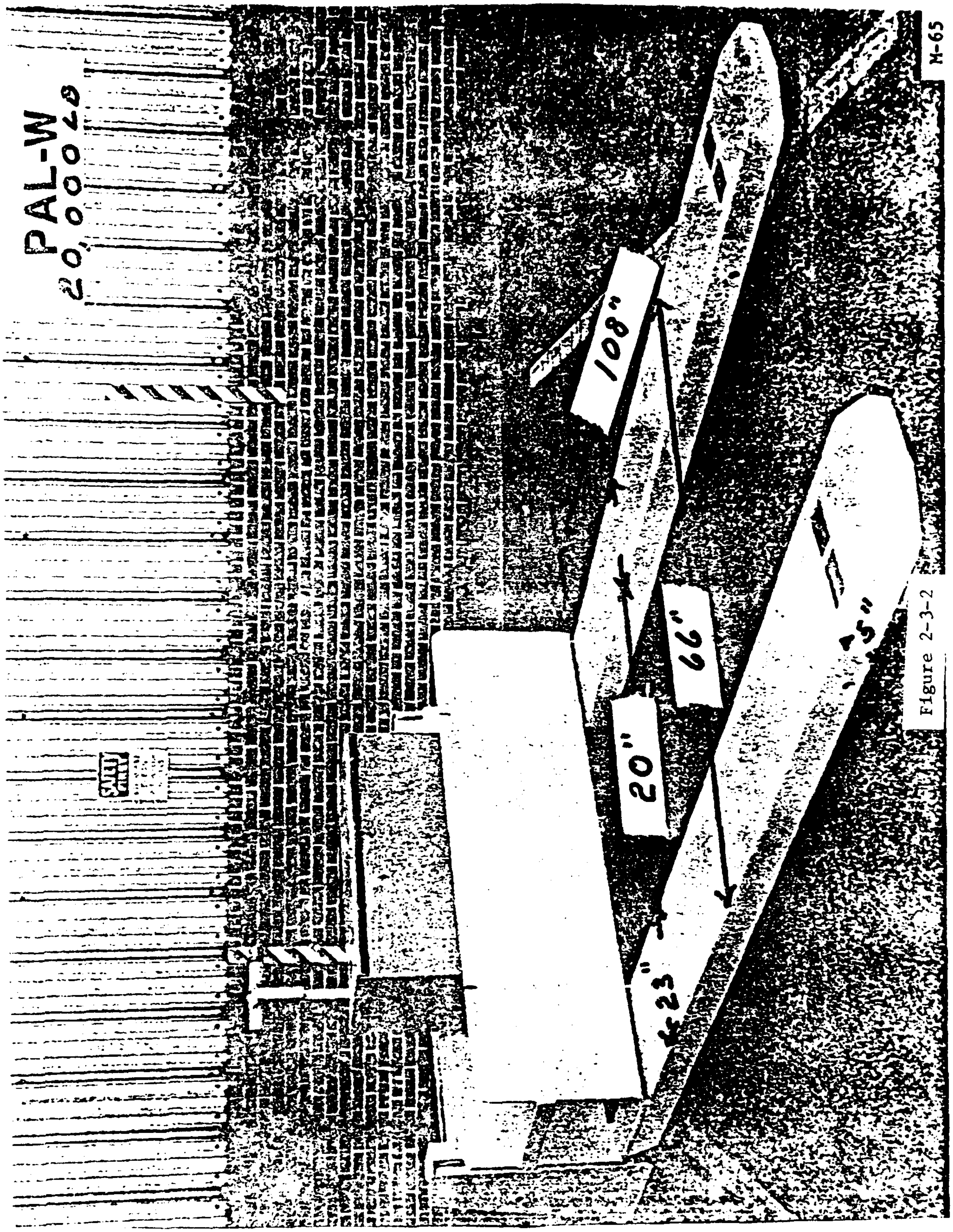


Figure 2-3-2

the dunnage shops to the igloo locations. An artist's rendition of the igloo portion of the cycle is presented in Figure 2-3-3.

The advantages and disadvantages of the powered low-lift truck and platform concept are presented in Figure 2-3-4. The only comments that Arthur D. Little has concerning the DACS/MERADCOM analysis is that the compatible dunnage system used to secure the platform in the containers is an integral dunnage or of the platform design concept and can be engineered for high degree of reliability and is not dependent upon the skills of the loading personnel.

Greater detail is presented on prestaged ammunition platform concepts in Appendix F which contains the Brooks & Perkins, Inc., Advanced Structures Division discussion and presentation on Prestaged Ammunition Platform. Also available, but not included in the Appendix, is a stress analysis No. 455 which is to substantiate structural adequacy of the design. It is dated March 1980 and prepared by Brooks & Perkins, Inc., 12633 Inkster Road, Livonia, Michigan 48150.

2.4 PALS ATS DOCK-MOUNTED CONTAINER LOADER SYSTEM

As has been previously pointed out, this concept is not a static prestaged ammunition loading system that exists in the igloo; there are no platforms involved for storage, transport and constraint. It is, however, a highly mechanized handling system that prestages the ammunition in the intra transport vehicle and transfers the prestaged load to and through the prestaged conveying subsystem and loads it into the container. The ATS system achieves a high throughput with improved productivity over the baseline wooden dunnage system. The igloo cycle consists of the movement of ammunition unit loads with a commercial 4,000 pound electric,

PALS
PRESTAGED IGLOO STORAGE

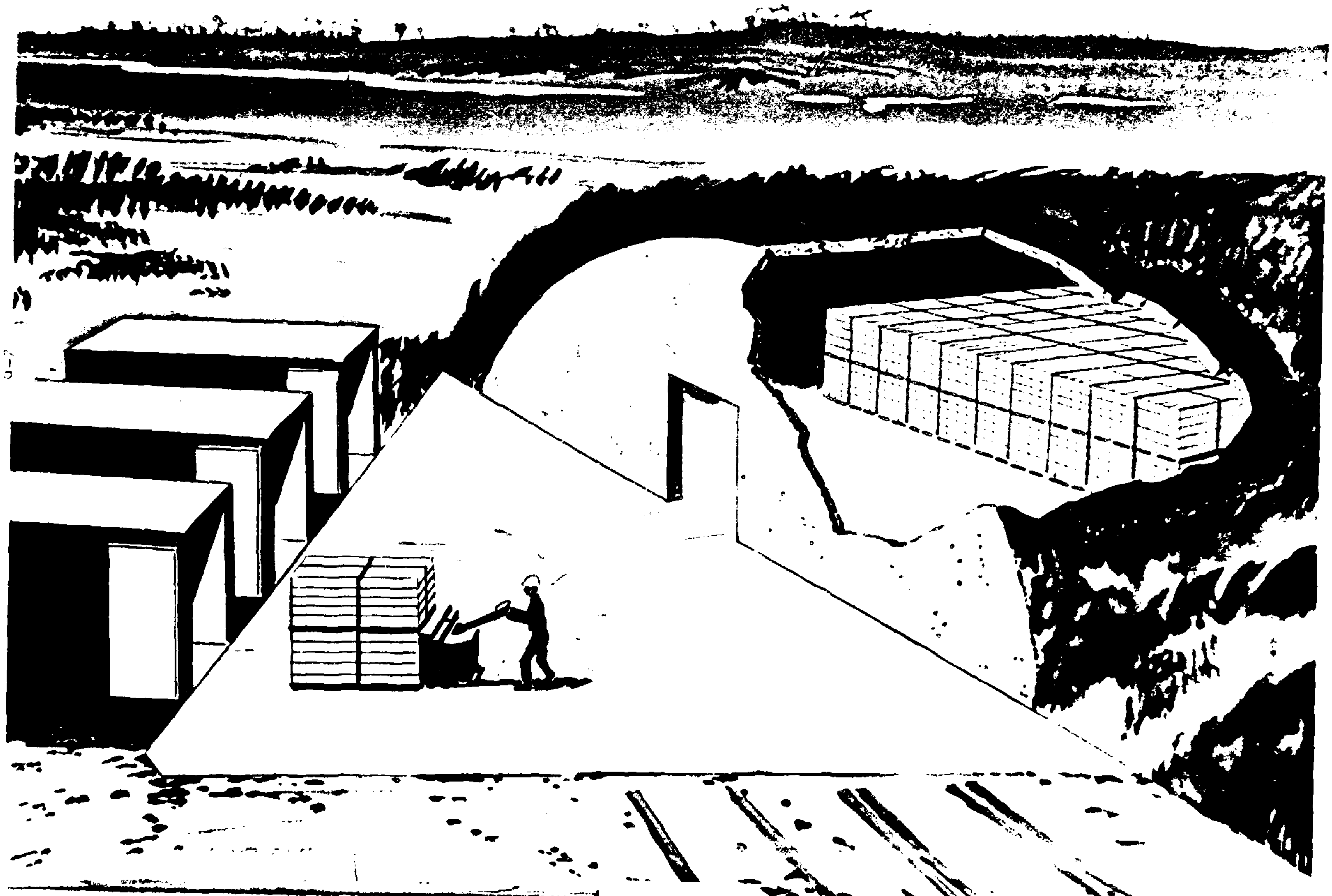


Figure 2-3-3

PALS

POWERED LOW-LIFT TRUCK & PLATFORM CONCEPT

ADVANTAGES

- PRESTAGED LOAD CAN BE STORED FOR READINESS.
- CONVENTIONAL DOCK LOADING FACILITIES NEEDED.
- LESS DOCK LOADING AREA NEEDED.
- LESS MANPOWER NEEDED.
- LOWER SKILL LEVEL NEEDED.
- LESS FORKLIFTS NEEDED.
- ACCEPTABLE CONTAINER TURNAROUND TIME.
- MINIMUM READINESS MAINTENANCE REQUIRED.
- PALS PLATFORMS CAN BE STRIPPED FROM CONTAINER IN THE FIELD USING SNAG & DRAG HANDLING EQUIPMENT.
- CAN BE USED TO SLED AMMUNITION IN COLD REGION COMBAT SUPPORT OPERATIONS (CONTINGENCY CAPABILITY)

DISADVANTAGES

- UNPROVEN SYSTEM
- NEED TO DEVELOP A COMPATIBLE DUNNAGING SYSTEM(S).
- NEED TO DEMONSTRATE SAFETY FOR AAR & CG APPROVAL.
- NEED TO ACQUIRE PALS IGLOO'S (MODERNIZE OLD OR BUILD NEW -?)
- PALS PLATFORM NOT SUITED FOR RAPID OUTLOADING AT THE PLANTS.
- CANNOT BE HANDLED IN THE FIELD BY TO & E FORKLIFTS (20 K).
- PLATFORM TRUCK REQUIRES HARDTOP SURFACE TO OPERATE.
- LIMITED GRADE PERFORMANCE 7%).

Figure 2-3-4

pneumatic-tired, forklift truck from the igloo storage to an ATS transfer truck. The ATS transfer truck contains a cable conveyor system in the bed of the truck to move the palletized load incrementally forward into the truck performing the prestaging of the load. The ATS transfer truck then unloads the full load from the truck automatically onto a powered roller prestaging conveyor at the container stuffing dock. The ATS dock-mounted container loader is presented schematically in Figure 2-4-1. The operation of the ATS cable bed trucks is presented in Figure 2-4-2 as a perspective cutaway.

The intra depot transport cycle is accomplished by the ATS cable bed truck transfer vehicles transporting the load from the igloo location to the container stuffing location and automatically unloading the ammunition cargo (equivalent to a container load) onto a roller conveyor subsystem which is an integral part of the dock-mounted mechanized container loader system. The igloo cycle and the intra depot transport cycle is presented in the artist's rendition in Figure 2-4-3. The container loading cycle is presented in the artist's rendition in Figure 2-4-4.

The container load of ammunition is unloaded from the ATS truck to the dock-mounted container loader conveyor which moves the ammunition load through a compactor-like fixture which aligns and sizes the load transversely on tracks and can be aligned selectively with any single container for automatic loading. The roller mat conveyor then moves forward delivering the load into the container. A hydraulic ram, which is not shown in the artist's concept but is part of the roller mat subsystem, would first hold and then push the load forward to compact it longitudinally while the roller mat conveyor is being extracted from beneath the ammunition

PALS
ATS DOCKMOUNTED CONTAINER LOADER SYSTEM

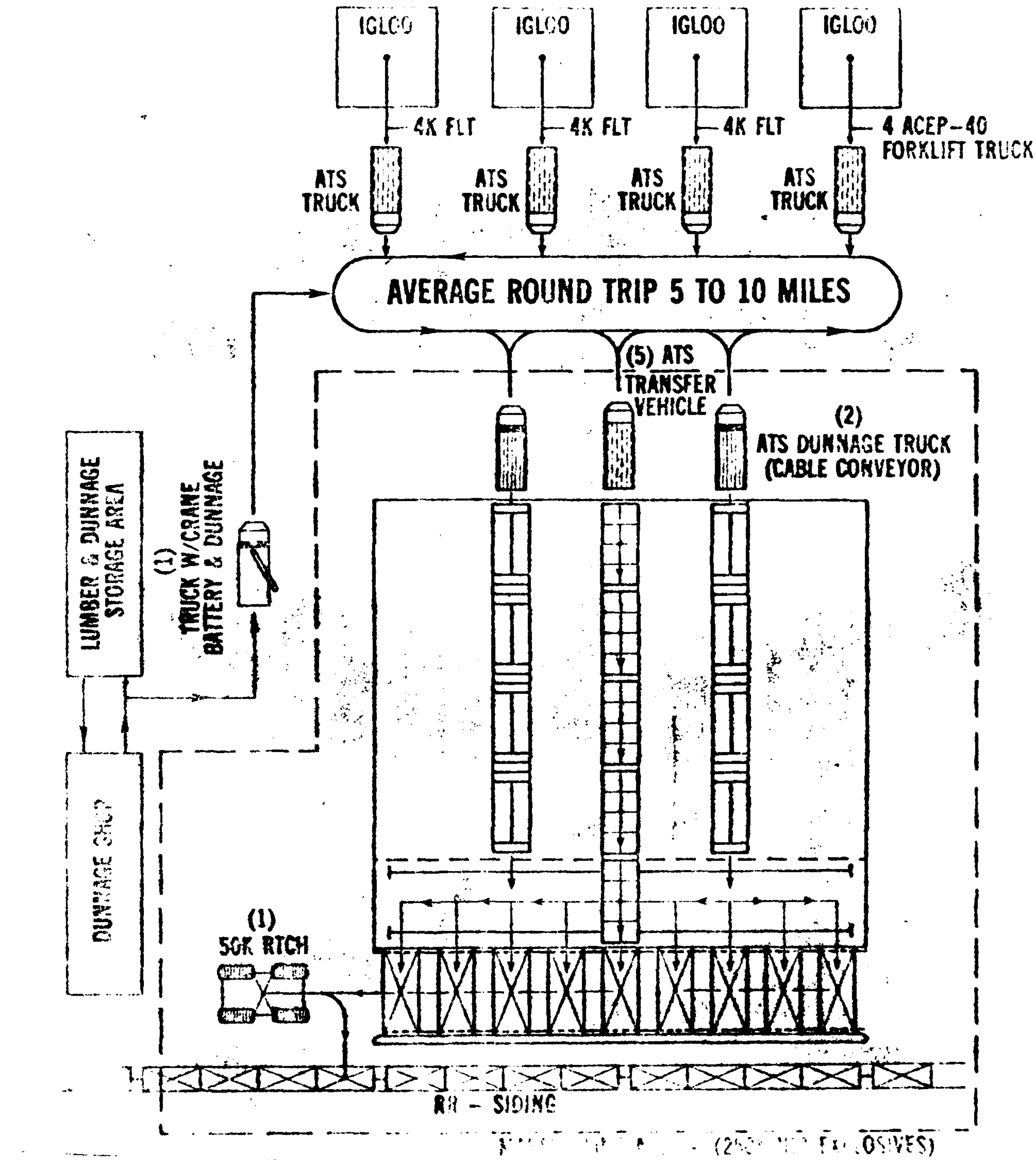


Figure 2-4-1

BENEFITS

FROM ½ TO 2 YEARS PAY-BACK PERIOD

LABOR AND TIME SAVINGS

- Manual unloading 40' trailer with hand truck requires up to 1¾ miles of wasted walking to tally within the vehicle
- Saves up to 50% or more in time over conventional loading and unloading methods
- Eliminate forklift transition and maneuvering time in vehicle
- Enables ground-based forktruck access to entire vehicle without the middle man
- Eliminate driver-helpers
- Helps eliminate driver fatigue
- Eliminate conveyor set up

- Entire load on/off in 5 minutes or less
- Rear position always full for forklift
- Rear position always full for hand loading or unloading
- Quicker turnaround
- More deliveries per vehicle

INVESTMENT SAVINGS

- Fewer trucks drivers needed to do the same job

BODY REPAIR SAVINGS

- Forklifts never need enter vehicle

CARGO DAMAGE SAVINGS

- Large crates, cartons, etc. move smoothly to rear with no risk of dropping. No jacks, bars pullers etc.

FEATURES

SPECIFICATIONS

Weighs 2,000 to 3,000 lbs., depending on unit.

Min. [illegible] above standard trailer floor to a max of [illegible]

VIRTUALLY INDESTRUCTIBLE

The tough steel cables cannot be damaged by heavy cargo, *entry of forklift*, dropping of heavy loads or broken glass, loose pallet boards, projecting nails etc.

SELF-CLEANING

Dirt cannot damage the system. Excess dirt can be swept or hosed off truck floor.

MINIMUM MAINTENANCE

There are no rollers or complicated mechanical parts used in the system. What minor adjustments or repairs that may become necessary are easily performed by your own personnel.

Handling up to 55,000 lbs. of freight, the cable floor adds power loading and unloading to your trailers.

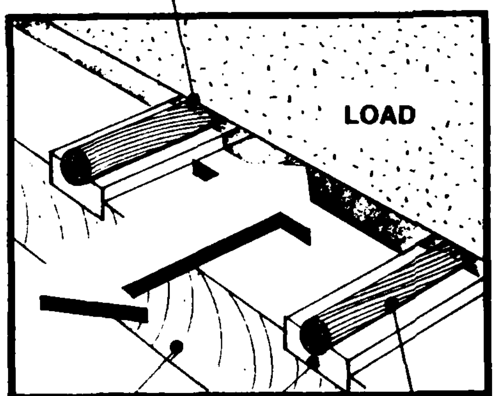
Trailer mates with powered conveyor equipment or special wear surfaces on your dock for full cube loading or unloading.

The cargo rests on cables at all times. Cables and bulkhead move only when loading or unloading. No rollers.

With push button ease, floor moves only when power unit is activated. Portable control station can be mounted on swing-arm for forktruck operator's easy reach, for control of load or unload movement.

Automatic sequencing is an optional addition which eliminates the need for an operator.

Load always rests secure on cables.



The ATS Cable Floor consists of a series of optionally spaced cables which slide along the vehicle floor in shallow tracks. The cargo rests directly on the cables, which when moved, act much like a belt conveyor. A bulkhead is attached to the cables to keep freight from falling forward. A driving mechanism powers the cables toward the front to load or toward the rear to unload. Optional limit switches to start/stop the action control the unit for completely automatic interface with forklift or other systems.

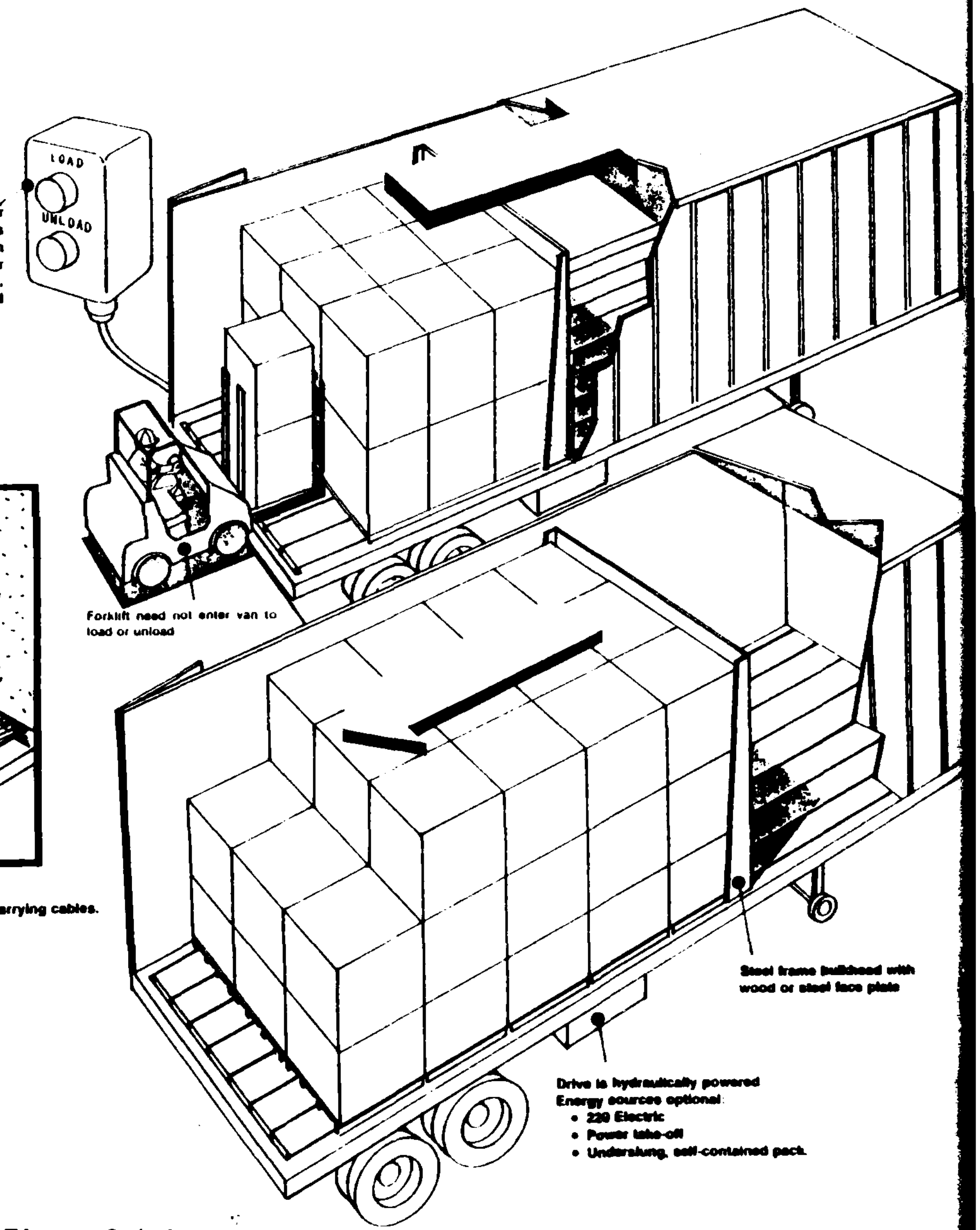


Figure 2-4-2

PALS
IGLOO TO CONTAINER LOADER LOAD TRANSFER VEHICLE

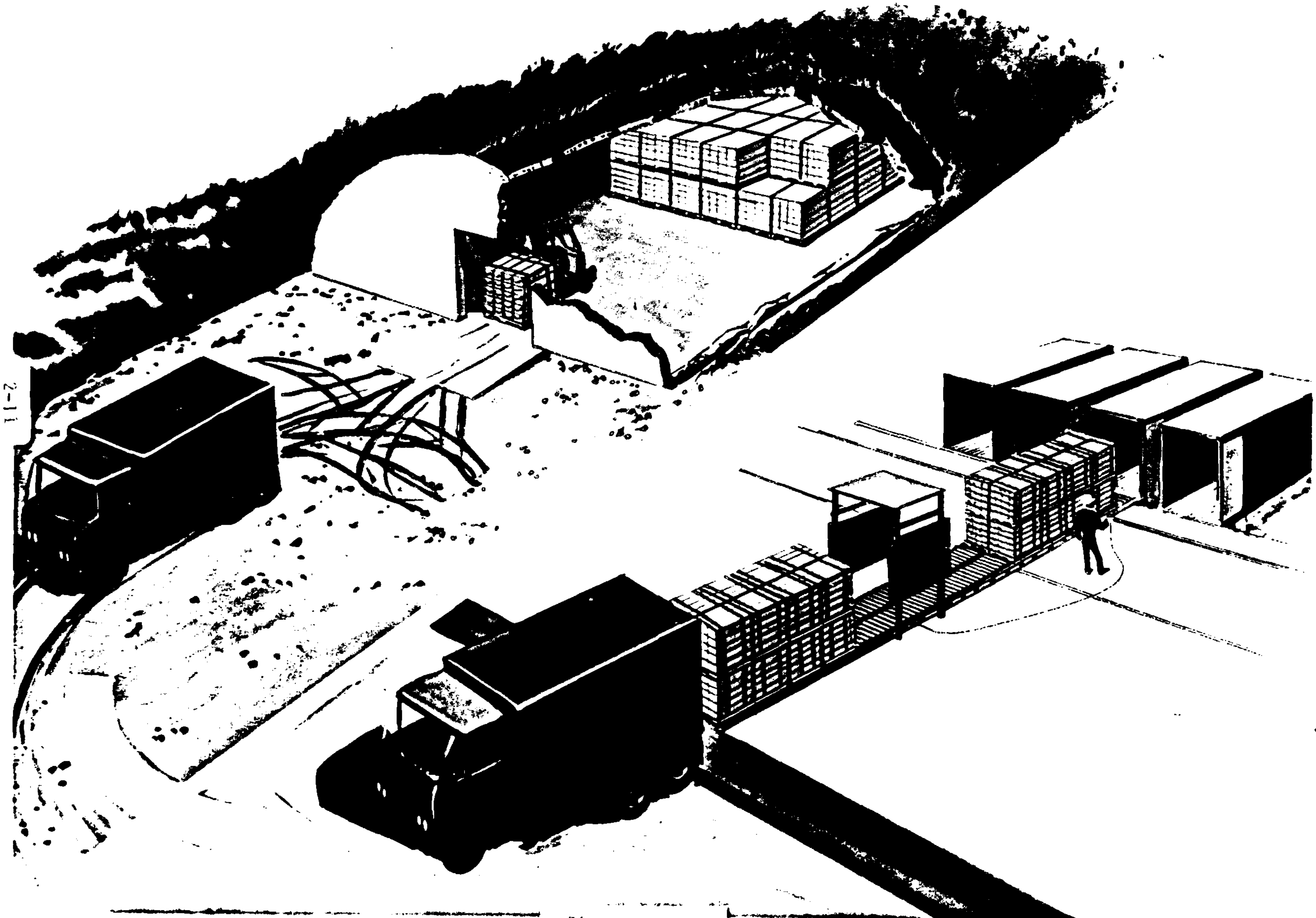


Figure 2-4-3

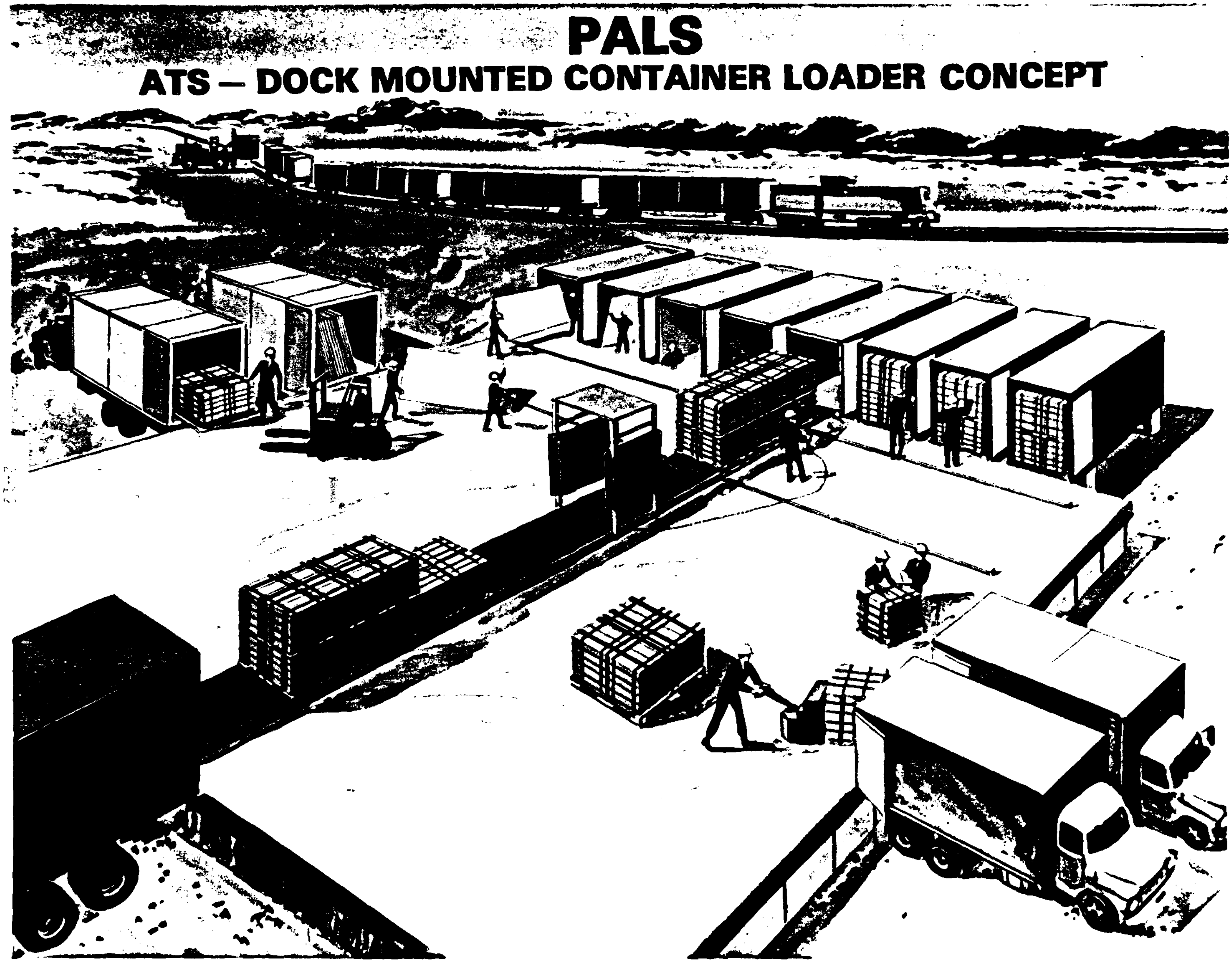


Figure 2-4-4

load. The dock-mounted loader is presented in a cutaway elevation view in Figure 2-4-5; again, the ram which restrains the load during retraction of the roller mat is not shown, rather a removable bar is shown which is an earlier version of the ram concept.

The dunnage cycle is shown in Figure 2-4-4, the dunnage being manually placed into the containers prior to the mechanized insertion of the ammunition load by the dock-mounted container loader. The loaded container handling cycle is also shown in Figure 2-4-4. The 50K pound rubber-tired container handler is in the process of loading the container on the rail car from the container stuffing dock.

It should be pointed out although the dock-mounted container loader has the capability of loading at random the container at any one of the nine container positions. In practice, because of the limitations of the 50K pound rubber-tired container handler, the container loading procedure must be highly ordered. Referring back to the system schematic in Figure 2-4-1, the 50K RTCH will be working the left side or the right side of the container line while the dock crew is installing dunnage and automatically loading ammunition into the containers on the other side. The 50K RTCH will progressively transfer loaded containers L1, L2, L3, L4, M (mid-container position) then transport empty containers to container positions M, L4, L3, L2, L1 before proceeding to work the righthand side of the container line. The recommended computer simulation model will develop the most effective procedures for this highly ordered regimen.

The advantages and disadvantages of the ATS dock-mounted container loader concept are presented in Figure 2-4-6. Arthur D. Little considers there are two additional disadvantages which have not been noted by the

Loading up to 50,000 lbs. of your prestaged freight into a standard trailer in 5 minutes.

The "turn-around" advantages are obvious. You need less docks. *Prestaging is done in the open* with either powered or non-powered conveyors or lift trucks.

When ready, the entire load and the roller mat is powered gently into the truck *in one smooth motion*. The dock and truck floor need not align perfectly because articulated track with top and bottom rollers automatically compensate for alignment variations.

Once in, the load is held in place with a stop-bar at the rear while the roller mat retracts to its original position. The truck is *loaded* and *can depart*. The conveyor is ready to receive the next load. Full cycle takes only 5 minutes. Power is hydraulic chain drives which are fully contained within the thickness of the dock-mounted loader. Where feasible the next load can be prestaged just behind the DML and by power conveyor or fork lift can be rolled onto DML as soon as it retracts.

Advantages

1. **Offers a prestaging area.**
   a) Shipper always has a "Trailer" to load.
   b) Eliminates down-time waiting for a trailer.
   c) Precount and check area.
   d) Lift trucks can work when you want.
   e) Minimizes distance a fork lift has to travel.
   f) Less accuracy needed with fork truck.
   g) Eliminates the need for dock plates.
2. **5 minute loading cycle**
   a) Less loading doors needed.
   b) Cuts down loading time.
   c) Minimizes driver wait.
   d) Minimizes added charges for trailer loading drop shuttle.
3. **Cuts down equipment damage**
   a) Fork-truck to trailer damage.
   b) Load-crushing by contact with trailer sides.

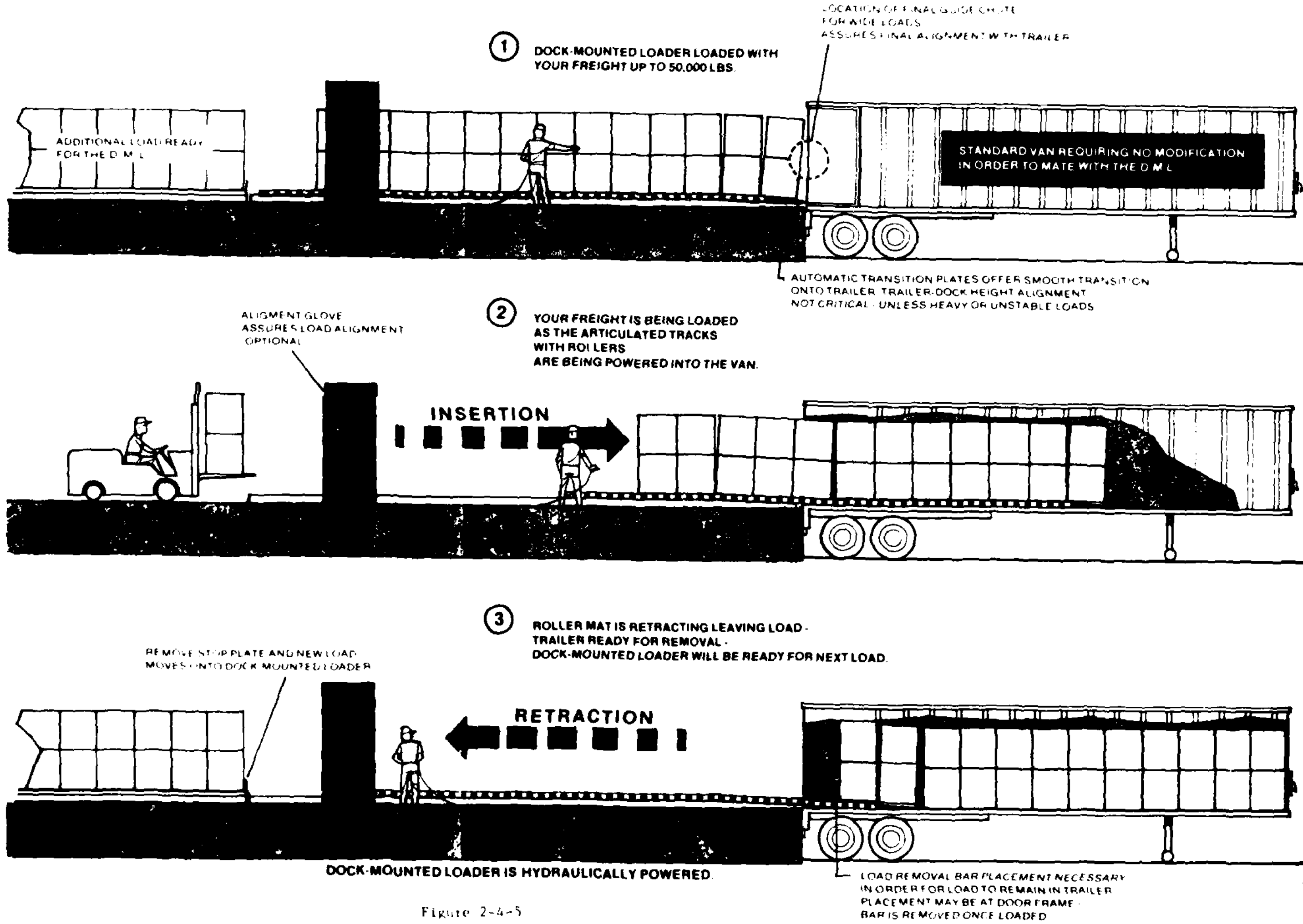


Figure 2-4-5

PALS

ATS — DOCK MOUNTED CONTAINER LOADER CONCEPT

ADVANTAGES	DISADVANTAGES
o STATE OF THE ART TECHNOLOGY.	o DEDICATED DEPOT/PLANT/PORT FACILITIES REQUIRED.
o PROVEN COMMERCIAL SYSTEM.	o READINESS MAINTENANCE REQUIRED.
o FLEXIBILITY OF CHARGING THE SYSTEM.	o NEED TO DEVELOP A COMPATIBLE DUNNAGING SYSTEM(S).
o PRESTAGED CONTAINER LOAD IS MACHINE ASSEMBLED.	o NEED TO DEMONSTRATE SAFETY FOR AAR & CG APPROVAL.
o EXISTING UNIT LOAD COMPATIBILITY.	o UNKNOWN CAPABILITY OF OPERATING IN CLIMATIC ZONES 1-6 (AR 70-380).
o EXISTING M.H.E. COMPATIBILITY.	
o LESS FORKLIFT ACCURACY NEEDED.	
o LESS FORKLIFTS NEEDED.	
o LOWER SKILL LEVELS NEEDED.	
o LESS MANPOWER NEEDED.	

Figure 2-4-6

PALS
ATS — DOCK MOUNTED CONTAINER LOADER CONCEPT (CONT)

ADVANTAGES	DISADVANTAGES
o LESS DOCK LOADING AREA NEEDED.	
o COMMERCIAL CONTAINER/VAN SIZE COMPATIBILITY.	
o ADAPTABLE TO DEPOT/PLANT/PORT CONTAINER OUTLOADING.	
o EXCELLENT CONTAINER TURNAROUND TIME.	
o IN THE FIELD TO & E COMPATIBILITY.	

Figure 2-4-6 (Cont'd.)

DACS/MERADCOM team. The first of these is that the igloo cycle is not efficient unless an ATS transfer truck is at the igloo during which time the ATS truck driver is idle. It should be noted that the truck driver could be utilized to index the stack* of ammunition (lateral row) one position as required. Arthur D. Little believes this task could be equally well performed by the forklift operator, the commercial practice for ATS cable bed trailers. Hence there must be a sufficient number of ATS transfer trucks available to provide a truck at an outloading igloo at all times for an efficient igloo cycle. The second disadvantage is a very important and critical safety hazard. It is the potential hazard of a person entrapped in the container during the automatic dock-mounted container loading cycle. Without proper management cognizance of safety procedures, the entrapped person could be seriously injured or crushed to death.

2.5 PALS BASELINE SYSTEM - THE WOODEN DUNNAGE SYSTEM

This is the present system approved for outloading ammunition in commercial ISO containers. The typical configuration of the system is presented schematically in Figure 2-5-1. For the igloo cycle, 12 igloos are operational (being stripped simultaneously) rather than four for the other two PALS concepts. There is an igloo outloading crew of two forklift operators per shift for each igloo. One forklift driver operates an electric forklift within the igloo and transports the ammunition load from the location within the igloo to the door of the igloo. The second forklift operator picks up the load from the igloo doorway and carries the load from the door of the igloo to a straddle carrier skid base located approximately 70 feet away. The straddle carrier skid base will hold

*The definition of stack and other container terminology is presented in Appendix I (railroad terminology for box cars).

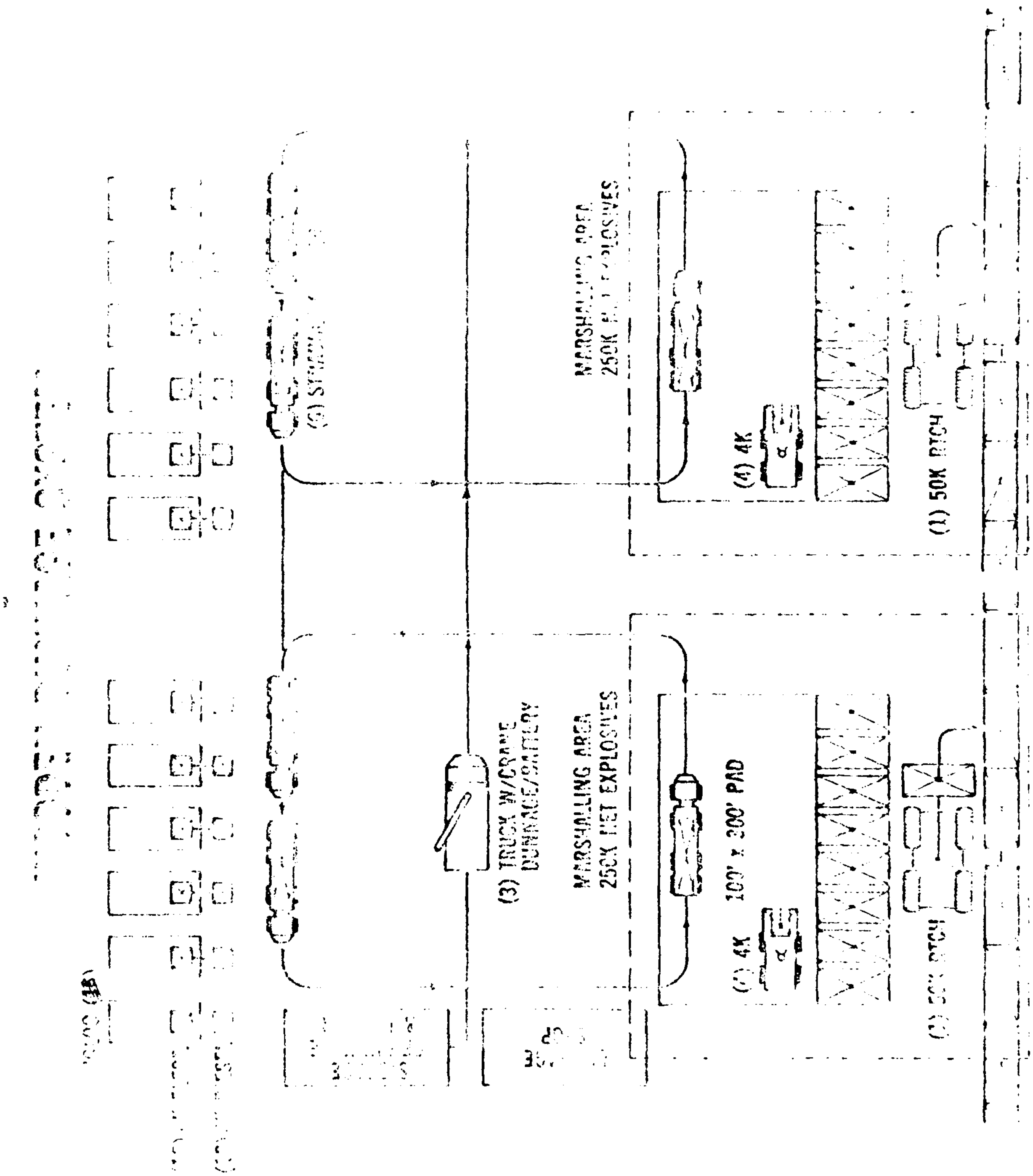

(3) TRUCK W/CRANE
DUNNAGE/BATTERY
MARSHALLING AREA
250K NET EXPLOSIVES
100' x 300' PAD
(4) 4K
(1) 50K RTCH

Figure 2-5-1

usually less than (65 to 96%)** a container load of ammunition. Unstuffing 12 igloos simultaneously is the present planned practice and is not based upon an industrial engineering analysis as are the unstuffing operations for the two other PALS concepts.

The intra depot transport cycle consists of a tractor with straddle carrier trailer picking up the skid base at the igloo and depositing the full skid base at one of the two stuffing docks and then picking up an empty skid base at the stuffing dock and returning the empty skid base to one of the igloos.

One weak point in the intra depot transport cycle is the requirement of the straddle carrier driver to back the trailer straddle carrier over the skid base in the loading mode. We would estimate that this maneuver would take approximately two to three minutes, depending upon the skill of the straddle carrier tractor driver and the prevailing environmental conditions.

The container loading cycle involves the utilization of a 4,000 pound forklift to move the palletized ammunition loads from the straddle carrier platform into the container. The container loading cycle involves the use of a 50K pound rubber-tired container handlers to move the full container from the stuffing pad to the rail car.

The dunnage cycle is considered to be the same as the dunnage cycle for the ATS system. Both would be capable of using metal-wood-foam, etc., composite structure based on future improved lightweight ammunition dunnage methodology.

**Typical skid base capacity as compared with ISO container capacity was furnished by DACS and is presented in Appendix J.

2.6 COMPARISON OF THE PALS LOW-LIFT TRUCK AND PLATFORM CONCEPT WITH THE BASELINE WOODEN SYSTEM

A comparison of the equipment and manpower required for the wooden system and the PALS platform concept is presented in the following tables by cycle. The igloo cycle is presented in Table 2.6.1; the intra depot transport cycle is presented in Table 2.6.2; the container loading cycle is presented in Table 2.6.3. Note that the platform system does not have a container loading cycle following the intra depot transport cycle. The container stuffing occurs at the igloo, hence container loading is incorporated as part of the igloo cycle. The full container handling cycle is presented in Table 2.6.4. The dunnage cycle is presented in Table 2.6.5. A summary of all the cycle costs is presented in Table 2.6.6.

The findings of this comparison are that the platform concept is not cost effective when compared with the baseline wooden system. There are two major cost items that are the basis of the defeat of the platform concept from a cost effectiveness standpoint. The first of these is the $2,416,000 average investment per depot for igloo modifications--(double doors and aprons)--and the second is the cost of dunnage materials per depot, namely, $5,577,000 which includes the cost of $3,750,000 for platforms. The additional cost per container is $1,456, or the platform concept costs approximately 60% more than the baseline wooden dunnage system.

On the basis of the second "must" criteria* for determination of effectiveness, Arthur D. Little concluded that the platform system was not cost effective when measured against the current baseline system and hence no further consideration has been given to the low-lift truck and platform concept as a viable, prestaged ammunition loading system.

*"2. Be cost effective when measured against the current baseline system."

TABLE 2.6.1
PALS
IGLOO CYCLE

		SYSTEM			
		WOODEN		PLATFORM	
EQUIPMENT ITEM	UNIT COST	QTY	INVESTMENT/ COST	QTY	INVESTMENT/ COST
(1) 4K FORKLIFTS, ELECTRIC (SMALL WHEELS)	$ 20,000	12	$240,000	-	-
(2) 4K FORKLIFTS, GED, PNEUMATIC	$ 17,000	12	204,000	-	-
(3) 20K PLATFORM TRUCKS	$ 20,000	-	-	4	$ 80,000
(4) 50K CONTAINER HANDLER (RUBBER TIRED)	$162,000	-	-	1	162,000
(5) IGLOO MODIFICATIONS (DOUBLE DOORS & APRONS PER DEPOT)	$ 16,000	-	-	151	2,416,000
(6) MAGAZINE APRON MODIF.	625 FT^2 x $4 = $ 2,500	-	-	100	250,000
EQUIPMENT CYCLE TOTAL			$444,000		$2,908,000

CONT'D

TABLE 2.6.1 (CONT'D.)

PALS

IGLOO CYCLE

CONT'D

		System			
		Wooden		Platform	
Manning	Unit Cost	QTY	Investment/ Cost	QTY	Investment/ Cost
(1) Operator, Elect. Forklift	$50/hr. x 10 hrs./ shift x 2 shifts x 25 days = $25,000	12	$ 300,000	-	-
(2) Operator, GED, Pneumatic Forklift	$25,000/2 shift	12	300,000	-	-
(3) Operator, Platform Truck	$25,000/2 shift	-	-	3	$ 75,000
(4) Operator, 50K RTCH	$25,000/2 shift	-	-	1	25,000
(5) Outloading Crew	$25,000/2 shift	-	-	9	225,000
Manning Cycle Total			$ 600,000		$ 325,000
	Grand Total		$1,044,000		$3,233,000

Table 2.6.2

PALS

INTRA DEPOT TRANSPORT CYCLE

		System			
		Wooden		Platform	
Equipment Item	Unit Cost	QTY	Investment/Cost	QTY	Investment/Cost
(1) Straddle Trailer/Tractor	$ 40,000	6	$ 240,000	-	-
(2) M871 22.5 ton Transporters	$ 16,000	-	-	4	$ 64,000
(3) M878 Yard Tractors	$ 50,000	-	-	4	200,000
Equipment Total			$ 240,000		$264,000
Manning					
(1) Operator, Straddle Carrier	25,000/2 shift	6	$ 150,000	-	-
(2) Operator, Transporters	25,000/2 shift	-	-	4	$100,000
Manning Total			$ 150,000		$100,000
	Grand Total		$ 390,000		$364,000

TABLE 2.6.3

PALS

CONTAINER LOADING CYCLE

		System			
		Wooden		Platform	
Equipment Item	Unit Cost	QTY	Investment/ Cost	QTY	Investment/ Cost
(1) Loading Dock	$13/FT^2	600 FT^2	$ 780,000	No Separate Platform Container Loading Cycle-Included in Igloo Cycle	
(2) 4K Lowmast Forklift	$15,000	8	120,000		
Equipment Total			$ 900,000		
Manning					
(1) Operator, Forklift	25,000/2 shift	8	$ 200,000		-
(2) Crew, Outloading	75,000/2 shift	7.5	562,000		-
Manning Total			$ 762,000		-
	Grand Total		$1,662,000		-

Table 2.6.4

PALS

FULL CONTAINER HANDLING CYCLE

		System			
		Wooden		Platform	
Equipment Item	Unit Cost	QTY	Investment/ Cost	QTY	Investment/ Cost
(1) 50K RT Container Handler	$162,000	2	$ 324,000	1	$ 162,000
Manning					
(1) Operator, Container	$25,000/2 shift	2	50,000	1	25,000
	Grand Total		$ 374,000		$ 187,000

TABLE 2.6.5

PALS

DUNNAGE CYCLE

		System			
		Wooden		Platform	
Equipment Item	Unit Cost	QTY	Investment/ Cost	QTY	Investment/ Cost
(1) Cargo Truck w/Crane	$50,000	3	$ 150,000	3	$ 150,000
Manning					
(1) Operator, Cargo Truck	$25,000/2 shift	6	150,000	6	150,000
(2) Carpenter, Dunnage	$25,000/2 shift	8.4 M/ HRS./ CONT.	1,050,000	4	100,000
Manning Total			$1,200,000		$ 250,000
Material					
(1) Platforms	$ 750	-	-	5,000	$3,750,000
(2) Corner Restraint Bars	$156/container	2,500	$ 390,000	2,500	390,000
(3) Lumber & Plywood	-	$364/cont	910,000	$50/cont	125,000
(4) Mech. Restraint Members	-	-	-	$525/cont	1,312,000
Material Total			$1,300,000		$5,577,000
	Grand Total		$2,650,000		$5,977,000

TABLE 2.6.6

SUMMARY OF CYCLE COSTS $(000)

	SYSTEM					
	WOODEN			PLATFORM		
CYCLE	EQUIP.	LABOR	TOTAL	EQUIP.	LABOR	TOTAL
IGLOO	444	600	1,044	2,908	325	3,233
INTRA DEPOT TRANSPORT	240	150	390	264	100	364
CONTAINER LOADING	900	762	1,662	-	-	-
FULL CONTAINER HANDLING	324	50	374	162	25	187
DUNNAGE (INCL. PLATFORMS)	150	1,200 (MAT'L) 1,300	2,650	150	250 (MAT'L) 5,577	5,977
TOTAL	2,058	4,062	6,120	3,484	6,277	9,761
PER CONTAINER $			2,448			3,904

2.7 COMPARISON OF THE ATS (CABLE BED TRANSFER VEHICLE AND DOCK-MOUNTED ROLLER MAT CONTAINER LOADER) CONCEPT WITH THE PRESENT BASELINE WOODEN DUNNAGE SYSTEM

A comparison of the equipment and manpower required for the wooden system and the PALS ATS concept is presented in the following tables by cycle. The igloo cycle is presented in 2.7.1; the intra depot transport cycle is presented in Table 2.7.2; the container loading cycle is presented in Table 2.7.3; the full container handling cycle is presented in Table 2.7.4; the dunnage cycle is presented in Table 2.7.5; and the summary of all cycle costs is presented in Table 2.7.6.

The Arthur D. Little findings concerning this comparative analysis are that:

1. The igloo cycle is questioned from an industrial engineering standpoint. The wooden system would require as many as 24 forklift operators as compared with the ATS system that requires only four. We question this productivity improvement factor of six since the wooden system can have an igloo crew that is working all the time loading the straddle carrier skid bases with palletized ammunition. While in the case of the ATS system, the igloo crew can only load when an ATS transfer truck is at the igloo. Hence, we have questioned and disregarded the savings alleged to be a result of improved productivity within the igloo cycle.

We have recommended that this igloo cycle be completely reevaluated. Since the submission of the rough draft report, DACS has made a time study of the typical outloading operation at Savanna Army Depot for an eight hour shift. The commodity item was 8 inch SLP's. This time study and the resulting findings are presented in Appendix K. The cycles that were

TABLE 2.7.1
PALS
IGLOO CYCLE

		System Wooden		ATS	
Equipment Item	Unit Cost	QTY	Investment/ Cost	QTY	Investment/ Cost
(1) 4K Forklifts, Electric (small wheels)	$20,000	12	$ 240,000	-	-
(2) 4K Forklifts, Electric/Pneumatic	20,000	-	-	4	$ 80,000
(3) 4K Forklifts, GED, Pneumatic	17,000	12	204,000	-	-
Equipment Cycle Total			$ 444,000		$ 80,000
Manning					
(1) Operator, Electric Forklift	$50/hr. x 10 hrs./ shift x 2 shifts/ day x 25 days = $25,000	12	$ 300,000	4	$100,000
(2) Operator, GED, Pneumatic Forklift	$25,000/2 shift position	12	300,000	-	-
Manning Cycle Total			$ 600,000		$100,000
	Grand Total		$1,044,000		$180,000

TABLE 2.7.2

PALS

INTRA DEPOT TRANSPORT CYCLE

		SYSTEM			
		WOODEN		ATS	
EQUIPMENT ITEM	UNIT COST	QTY	INVESTMENT/ COST	QTY	INVESTMENT/ COST
(1) STRADDLE TRAILER/ TRACTOR	$40,000	6	$ 240,000	-	-
(2) 20 TON ATS SHUTTLE TRUCKS	80,000	-	-	5	$400,000
MANNING					
(1) OPERATOR, STRADDLE CARRIER	$25,000/2 SHIFT POSITION	6	$150,000	-	-
(2) OPERATOR, SHUTTLE TRUCK	$25,000/2 SHIFT POSITION	-	-	5	$125,000
MANNING CYCLE TOTAL			$150,000		$125,000
	GRAND TOTAL		$390,000		$525,000

Table 2.7.3
PALS
Container Loading Cycle

Equipment Item	Unit Cost	System: Wooden QTY	Wooden Investment/Cost	ATS QTY	ATS Investment/Cost
(1) Loading Dock	$ 13/Ft.^{2}	2(100'x 300')	$780,000	-	-
(2) Loading Dock	16/Ft.^{2}	-	-	1(100'x 120')	$192,000
(3) 4K Forklift, Low Mast, GED	15,000	8	120,000	-	-
(4) Dock Mounted Container Loader	300,000	-	-	1	300,000
Equipment Total			$900,000		$492,000
Manning					
(1) Operator, Forklift	$25,000/2 shift position	8	$200,000	-	-
(2) Operator, Dock Mounted Container Loader	$25,000/2 shift position	-	-	1	$ 25,000
(3) Operator, Prestaging and Load Sizing Ramp	$25,000/2 shift position	-	-	2	50,000
(4) Crew, Outloading	3 men/shift or $75,000/2 shift operation (7.5) @ 4.5 MH/container	-	562,000	2	150,000
Manning Total			$762,000		225,000
Grand Total			$1,662,000		$717,000

Table 2.7.4

PALS

FULL CONTAINER HANDLING CYCLE

		System			
		Wooden		ATS	
Equipment Item	Unit Cost	QTY	Investment/ Cost	QTY	Investment/ Cost
(1) 50K RT Container Handler	$162,000	2	$324,000	1	$162,000
Manning					
(1) Operator, Container Handler	$ 25,000/2 shift position	2	$ 50,000	1	$ 25,000
Grand Total			$374,000		$187,000

TABLE 2.7.5
PALS
DUNNAGE CYCLE

		SYSTEM				
		WOODEN			ATS	
EQUIPMENT ITEM	UNIT COST	QTY	INVESTMENT/ COST		QTY	INVESTMENT/ COST
(1) CARGO TRUCK WITH CRANE	$50,000	3	$150,000		1	$ 50,000
(2) CARGO TRUCK WITH ATS CABLE CONVEYOR	$50,000	-	-		2	100,000
EQUIPMENT CYCLE TOTAL			$150,000			$150,000
MANNING						
(1) OPERATOR, CARGO TRUCK	$50/HR.x10 HRS./SHIFT X 2 SHIFTS/ DAY X 25 DAYS = $25,000/ DOUBLE SHIFT	6	$150,000		4	$100,000
(2) CARPENTER, DUNNAGE PRE-FABRICATION	8.4 M/HRS./ CONTAINER X $50/HR. = $420/CON-TAINER		$1,050,000	2.4 M/ HRS.X $50/HR.= $120/CON-TAINER		300,000
LABOR CYCLE TOTAL			$1,200,000			$400,000
MATERIAL						
(1) CORNER RESTRAINT BARS	$156/CON-TAINER	2,500	$ 390,000	$156/CON-TAINER		$390,000
(2) LUMBER AND PLY-WOOD	$364/CON-TAINER	2,500	910,000	$300/CON-TAINER		750,000
MATERIAL CYCLE TOTAL			$1,300,000			$1,140,000
GRAND TOTAL			$2,650,000			$1,690,000

TABLE 2.7.6

SUMMARY OF CYCLE COSTS $(000)

	SYSTEM					
	WOODEN			ATS		
CYCLE	EQUIP.	LABOR	TOTAL	EQUIP.	LABOR	TOTAL
IGLOO	444	600	1,044	80	100	180
INTRA DEPOT TRANSPORT	240	150	390	400	125	525
CONTAINER LOADING	900	762	1,272	492	225	717
FULL CONTAINER HANDLING	324	50	374	162	25	187
DUNNAGE	150	MATER-IAL 1,200 1,300	1,662	150	MATER-IAL 400 1,140	1,690
TOTAL $(000) PER CONTAINER $	2,058	4,062	6,120 2,448	1,284	2,015	3,299 $1,319
TOTAL W/O DUNNAGE	1,908	1,562	3,470	1,134	475	1,609
TOTAL W/O DUNNAGE & IGLOO $(000) PER CONTAINER $	1,464	962	2,426 $970.40	1,054	375	1,429 $571.60
SAVING $(000)						997
SAVING $/ CONTAINER						$398.80

studied were the igloo (unstuffing igloo) cycle, intra depot cycle, container stuffing area cycle, and container handling cycle. For the igloo cycle the finding was that a round trip for both forklifts took between three and four minutes. Hence, to unstuff one container of 155 mm ammunition would require 14 lifts of the two forklifts. Each lift would consist of three pallets of 155 mm ammunition. The time for handling the 14 lifts for a three minute round trip cycle would be 42 minutes and for a four minute round trip cycle would be 56 minutes.

This finding by DACS can be interpreted as a requirement for 10 minute average outloading cycle time per container, which is the mobilization need, would be the simultaneous unstuffing of six igloos rather than the 12 as specified in the wooden system comparison.

Arthur D. Little believes that an improved wooden system can have the same improved productivity for its igloo cycle as is projected for in the ATS concept for the igloo cycle. We believe that by adding to the wooden systems the pneumatic tired forklifts and replacing the 12 small wheeled electric forklifts operating within the igloo and replacing the 12 gasoline or diesel pneumatic tired forklifts that work outside the igloo, the wooden system would show similar savings for the igloo cycle as does the ATS igloo cycle.

The second cycle comparison that we have questioned and disregarded is the dunnage cycle. We do not believe there is anything inherent within the ATS system other than the method of handling some dunnage on the unitized load prior to automatically loading the ammunition into the container that makes the ATS system unique from the baseline system. We recognize that the load of ammunition is unitized on the ATS loading system and that for an improved wooden system the unitized load, of necessity, would be accomplished only within the container, lift-by-lift. We also recognize that for the ATS system the hydraulic ram can compress the load longitudinally within the container as the roller mat is being withdrawn. We believe, however, that forklift operators, as is the present practice, can compress lift-by-lift as the container is loaded in the improved wooden system. The productivity, of course, is dramatically in favor of the ATS system for this ammunition loading procedure. However, the productivity for the improved dunnage system, we believe, would be a probable standoff between an improved wooden system utilizing the new dunnage and the ATS concept. The material and manpower needs for the improved dunnage would be about the same for both systems. Hence, we believe that any saving by improved dunnage for the ATS concept could also be accomplished for the baseline system.

On the basis of including the savings only from the intra depot transport cycle, the container loading cycle, and the full container handling cycle, the ATS system is still highly cost effective in comparison with the baseline system. The cost for the ATS system would be $1,429,000 in comparison with $2,426,000 for the baseling system, or offering a savings per depot of $997,000. The savings per container would be $398.80. This analysis assumes that both for the wooden system and ATS concept all new equipment would have to be acquired.

At the final oral report meeting at MERADCOM the question was asked what would the justification be for the PALS ATS concept if some of the equipment existed for the wooden system and did not have to be acquired. The analysis required to answer this question is outside the scope of this study. Depending upon the conditions that exist at any individual depot, the ATS system could be highly cost effective or possibly closer to a break-even with the wooden system if some of the equipment exists and would be applicable to the wooden system and some could also be applicable to the ATS system. DACS has provided a listing of equipment that exists as of April 1980 at each depot. These listings are presented in Appendix L. It should be noted that 50K pound container handling equipment exists at 14 depots; at most there are two or more available. There also exists straddle trailer equivalents at each of the 14 depots and at some as many as 10; there also exists low mast forklifts. The recommended simulation model would be a most useful tool to evaluate the cost effectiveness of the ATS system in detail at each of the 15 depots.

The minimum investment for the ATS system if the facilities existed and other equipment not unique to the ATS system existed would be:

> The ATS shuttle trucks used in the intra depot transport cycle - \$400,000, and the dock mounted container loader used in the container loading cycle - \$300,000, or a total of \$700,000.

The labor saving for the ATS concept over the wooden system for the three pertinent cycles, namely, intra depot transport, container loading, and full container handling amount to \$962,000 minus \$375,000, or \$587,000. Hence, if common equipment existed for both the wooden system and the ATS system, the ATS system would be close to break-even.

3.0 IDENTIFY VOIDS, QUESTIONABLE ANALYTICAL TECHNIQUES OR METHODOLOGIES (SUBTASK 2)

In section 2.7, the comparison of the ATS concept with the baseline system, we have brought up a number of questions concerning the projected savings of the ATS concept over the baseline system for two of the cycles, namely, the igloo and the dunnage. Arthur D. Little contended that the PALS savings may be realized but they would be realized with either the ATS concept or an improved baseline system.

3.1 QUESTIONING OF THE IGLOO CYCLE COMPARISON - ATS VERSUS BASELINE SYSTEM

An analysis has been made of the igloo cycle for the loading of the ATS transfer vehicle and it appears that the truck can be loaded from the igloo with the pneumatic-tired electric forklift in approximately 16.9 minutes for 155 mm ammunition. The assumption was that the forklift operator was skilled and made no wasted moves. Based upon the time study of DACS*for 8" SLP's, this time is too optimistic. Hence we have added an allowance of 35% for a new time of 22.8 minutes. On this basis, approximately two igloos unstuffing would provide sufficient ammunition loads for the 10-minute required average container outloading cycle. Hence, the assumption of operating with four forklifts and as many as four igloos unstuffing simultaneously is certainly adequate for the ATS system. The question we have with the igloo cycle is that the baseline system can be improved by utilizing the same forklift for the baseline as for the ATS system, but instead of loading the ATS truck, you load the baseline straddle carrier skid base. We cannot understand why there would not be close to a similar saving. On this basis and for these reasons, we have not allocated these savings for the igloo cycle to the ATS concept. We

*See Appendix K.

believe an analysis should be made of the igloo cycle for both the baseline and the ATS system utilizing a realistic time study or realistic simulation model based upon a time study of the pneumatic tired 4K forklift.

Based upon the manual simulation of the ATS igloo cycle, there is definitely indicated the need for six rather than five ATS transfer trucks. This analysis was based upon traveling a distance, with the truck full, of five miles at an average speed of 15 miles per hour, so the travel time would be 20 minutes between the igloo and the stuffing platform, and travel of five miles empty at an average speed of 20 miles per hour for the five mile trip. The empty travel time would be 15 minutes. Hence, the total combined cycle time for any transfer truck in the ATS system, including the 10-minute break per hour, would be 71.3 minutes. This breakdown is as follows:

Operation	Subcycle Time (Minutes)
Spot Truck at Igloo	1.0
Load	22.8
Travel Full	20.0
Unload	2.5
Travel Empty	15.0
Break	10.0

This combined cycle of the ATS transfer truck is a combination cycle of the igloo cycle and the intra depot transport cycle since the ATS transfer truck must wait at the igloo and participate in selfloading.

3.2 QUESTIONING OF THE DUNNAGE CYCLE

In Table 2.7.5, the dunnage cycle comparing the ATS concept with the baseline wooden dunnage system, the cost of the dunnage cycle for the baseline was $2,650,000 and for the ATS $1,690,000, for a potential saving of $960,000. It is Arthur D. Little's contention that the improved dunnage system associated with the ATS program would be equally applicable to the baseline system. The improvements in dunnage both material and productivity from the PALS concept can be applied to a specific type of ammunition to be stuffed in an ISO container no matter whether the container is stuffed by the ATS dock-mounted loader or by a forklift provided the load is comparably unitized. There is an unquestioned relationship between the dunnage system and the ammunition load requiring restraint, but not necessarily any relationship between the dunnage system and the ATS methodology for loading the ammunition into the container.

Arthur D. Little concurs in the development of new dunnage systems that will be compatible with the ATS unitized load of ammunition. However, if for any reason the ATS system is not implemented or is not operable, we believe the same dunnage system should be applied to the same load if the load has to be assembled and unitized in the container by the use of forklifts. In this latter instance, the forklift operator would provide the longitudinal compression as well as the lateral sizing of the individual lift, making up an integral load in the container that would be indistinguishable from a load prestaged on the ATS dock-mounted loader.

3.3 COST JUSTIFICATION OF THE ATS IF A PORTION OF THE EQUIPMENT REQUIRED FOR THE BASELINE WOODEN DUNNAGE SYSTEM EXISTED AT A DEPOT

The DACS/MERADCOM concept study based the cost effectiveness analysis upon the investment cost of all new equipment for the baseline wooden dunnage system. If only a portion of the investment cost were required, the question asked by MERADCOM staff was the cost effectiveness of the ATS system. The total savings of the ATS system over the baseline system is $997,000 when you include only the intra depot transport, container loading and full container handling cycles.

In the discussion that followed in section 2.7, Comparison of the ATS (Cable Bed Transfer Vehicle and Dock-Mounted Roller Mat Container Loader) Concept with the Present Baseline Wooden Dunnage System, this problem was discussed to the extent that it can be within the scope of the study. It was pointed out that the minimum labor saving of the ATS concept over the wooden system would be $587,000 per depot on the average, and the cost of the ATS shuttle trucks and dock-mounted container loader would approximate $700,000. Hence if common equipment existed for both the wooden system and the ATS system, the ATS system, under certain conditions could be very favorably cost effective, or could be break-even or could be marginally not cost effective. Again, we would like to iterate that the recommended simulation would be a most useful tool to evaluate the cost effectiveness of the ATS system in detail at each of the 15 depots.

3.4 QUESTION OF DEGREE OF REDUNDANCY WITH THE ATS SYSTEM

There are two single and potentially weak links for the ATS system as far as redundancy is concerned. The first weak link is the dock-mounted roller mat loader of which there is only one. DT/OT I RAM testing should determine the need for redundancy for the roller mat. The second is the 50K rubber-tired container handler of which there is only one. For the baseline wooden system there are two container handlers and there is a total of eight 4,000 pound forklift trucks for stuffing the containers on the two pads.

4.0 VISIT TO DEFENSE AMMUNITION CENTER SCHOOL (DACS) AT THE SAVANNA ARMY DEPOT, ILLINOIS, AND WITNESSED OUTLOADING AMMUNITION USING THE WOODEN DUNNAGE SYSTEM (SUBTASK 3)

On 16 and 17 July 1980 the Arthur D. Little team observed ammunition outloading operations at Savanna Defense Ammunition Center, Savanna, Illinois. These observations included the following:

4.1 OUTLOADING COMMERCIAL CONTAINERS

In the afternoon of 16 July we observed the outloading of 155 mm and 105 mm ammunition in two, 20 foot commercial containers. The container for the 105 mm ammunition load was a unique design of aluminum construction and was two to three inches wider than the normal ISO container in service. Hence, the prepared side wall dunnage allowed more clearance than permitted. Other precut dunnage components did not fit the container so that the outloading of the 105 mm ammunition was not completed. A partial time study* was made on the outloading of the 155 mm. The installing of the rear bulkhead was completed the following morning and not observed by the Arthur D. Little team. Assuming that the completion of installation took approximately 16+ minutes, the total time for outloading the 155 mm ammunition would be approximately one and one half hours by a crew of two men working in container and one man on forklift moving the ammunition from the pad into the container. The most time consuming component during the 155 ammunition outloading cycle was the insertion of the middle pallet load in each stack of ammunition within the container of which there were five stacks (forklift loads) in each of three rows. It was the first time this particular crew loaded a commercial ISO container. This demonstration confirmed the labor intensiveness of the baseline wooden dunnage system.

*See Table 4.1.1

Table 4.1.1

Time Study of Outloading 155 mm Ammunition in a 20 Foot ISO Container

Time	Operation	Manning
3:12 EDT	Start	2 Men in Container
	Installing forward bulkhead	1 Man on Forklift
3:18	Put in first of sidewalls	
3:31	2nd load, 3 pallets in load = 3 pallets righthand corner	
	Wedge 3rd load	
	4th load press against side dunnage with forklift	
3:46	Work on 6th load	
3:51	7th load	
3:53	8th load	
3:56	Still working on 8th load	
3:59	9th load	
4:06	11th load	
4:12	12th load	
	13th, 14th, and 15th 2 pallets per load	
4:20	15th in	

4.2 OBSERVATIONS OF OUTLOADING 8" PROJECTILES IN MILVAN CONTAINERS AT THE SAVANNA ARMY DEPOT

As part of our visit to the Savanna Army Depot, we observed the handling of 8" projectiles from a typical igloo and the outloading of a number of MILVAN containers at the rail head.

For the PALS program we are primarily interested in the outloading of commercial containers using the approved methods. Thus, the MILVAN outloading, although similar to the baseline wooden dunnage system for commercial containers, did not warrant quantitative data on the operations. Several points were observed qualitatively, however, which may bear upon the evaluation of the PALS system.

- The igloo facility observed did not have a dock or significant loading pad. The ammunition must be brought through a relatively narrow door and set on a small pad immediately outside the door.
- 4,000 pound electric forklifts are used inside the igloo and either electric or conventional gasoline forklifts outside.
- The unitized 8-inch loads (three to a pallet which were being banded into units of six) were placed over the axles of a conventional 10 ton flatbed trailer for transport to the rail head (of the order of one half to one mile).
- At the rail head, the MILVANS were lined up with their floors level with a large loading platform. The ammunition was removed from the trailers by forklift and loaded into the MILVANS by forklift.
- They reported that a four man crew can outload six to nine containers in an eight-hour shift (six working hours) 2.7 to 4 manhours per MILVAN.
- The mechanical dunnage system used in the MILVANS is similar to the baseline wooden dunnage system except that MILVAN metal restraint bars are used to provide longitudinal restraint of the load.
- The loads were also tommed using the MILVAN overhead restraint bars.
- We did not see any full container handling operations. However, we were told that the loaded containers are placed on flat cars with a 50K front or side handling container loader.

4.3 DUNNAGE PREFABRICATION AT SAVANNA

4.3.1 Introduction

The baseline wooden dunnage system uses well developed and tested procedures as presented to us by DACS in Drawings D-SARAC-4395 and D-SARAC-4411 for the restraining of 155 mm and 105 mm ammunition loads. These drawings are included for reference in Appendix H. The PALS ATS concept will also require approved outloading procedures which will safely transfer rail impact resultant forces into the main structural members of the container.

In projecting these systems up to a level of production for outloading 100 containers per day at each depot, the details of the dunnage prefabrication operations were not treated. At this stage of development of a PALS concept, it must be assumed that the dunnage preparation and handling cycle for the both the wooden and ATS systems would be similar.

To assess what facilities and manpower are required at each depot for dunnage preparation, we have studied the outloading data on the two limiting cases witnessed as well as the available information on existing capabilities. The results of these studies are discussed in this section.

4.3.2 Existing Facilities and Methods

While visiting Savanna Army Depot, we toured the dunnage fabrication shop to learn what is now typically available. This shop is located in a one-story building of the order of 2,000 ft^2 in size. It contains several power saws, tables and benches for prefabricating the dunnage components. It is manned by two carpenters who normally handle the prefabrication. In peak demand periods, they would do the cutting and would be supported by several nailers drawn from normal container outloading crews.

The capacity or throughput of this shop is measured in the order of 20,000 to 30,000 board-feet per month with most recent months considerably below this peak.

Table 4.3.1, which contains data excerpted from the drawings of Appendix H, shows that the lumber requirement for each container is likely to be about 900 board-feet. Thus, 2,500 containers per month will require over two million board-feet, or 100 times the current throughput. If the current baseline system operational methods were used, we estimate that about 200 carpenters would be required augmented by, perhaps, an equal number of nailers.

The above scenario, of course, is a poor indication of what the dunnage shop manpower requirements would be under mobilization conditions. A better estimate can probably be drawn from the time studies made at the Milan Army Ammunition Plant which covered the outloading of ten commercial containers with 105 mm ammunition. The data from this study are given in Appendix G.

The results showed that dunnage prefabrication for the ten containers required 129 man-hours. No details on the shop facilities that were used are given.

However, based upon extrapolating the manpower requirement for a dunnage prefabrication rate to outload 100 containers per day, the required manhours would increase from 129 to 1,290. Thus, if the crews were working two 10-hour shifts, this manpower requirement corresponds to a crew of approximately 65 men for each shift.

Table 4.3.1

Current Dunnage Requirements

	155 mm Board-feet	105 mm Board-feet
1 x 6	236	31
2 x 2	2	-
2 x 3	94	-
2 x 4	162	40
2 x 6	429	665
4 x 4	47	112
Total	970	848
1/2" Plywood	91 ft^2	0

4.3.3 Projected Requirements for Mobilization

In order to refine the estimate more closely for the mobilization condition for which the dunnage for 100 containers per day will be required, the two dunnage systems for 155 mm and 105 mm ammunition as presented in Appendix H were studied.

Each of the dunnage assemblies was visualized to require a production setup for flow of work through a sawing operation to an assembly table on which the individual pieces would be placed and located by means of a jig and nailed together with pneumatic nailers.

The time required at each station was estimated from the number of cuts, pieces, or nails. Thus, the total cycle time at each station was calculated. In general, the assembly/nailing operation is inherently slower than the cutting and, thus, several assembly tables are required for each saw. The larger assemblies would require two to four men to handle at each station while several of the smaller assemblies would require only one.

An example of a line for the Side Fill Gates on the 155 mm case is shown in Figure 4.3.1. It can be seen that this line consists of one radial arm saw feeding four assembly areas. The total bench and table area is about 750 ft^2. If operated for two 10 hour shifts per day, it would be capable of producing 240 Side Fill Gates per day. Thus, two complete lines of this size would be required for the 400 Side Gates required in 100 containers per day.

Similar estimates were made for each of the dunnage assemblies used in the 155 mm and 105 mm loads. The total floor space and manning requirements for each of these loads, assuming 100 containers per day in two 10-hour shifts are summarized in Tables 4.3.2 and 4.3.3.

Floor space was assumed to be 1.5 times bench and table space in order to provide clear aisles for movement of personnel and material.

It can be seen from Tables 4.3.2 and 4.3.3 that both of these loads would require a 4,000 ft^2 dunnage shop manned by 120 to 150 men. These estimates, especially the floor area, might increase somewhat when the diversity of assemblies for all of the possible container loads is taken into account. For example, the 155 mm load requires 27 separate saw or assembly areas while the 105 mm requires only 18. This is principally due to the small separator assemblies used in the 155 mm load which require additional small work areas which do not add greatly to the required floor space.

The manpower estimates do not differ markedly from the 64.5 men per shift based upon the scaled up projection of the 10 container Milan time study presented in Table 4.4.1.

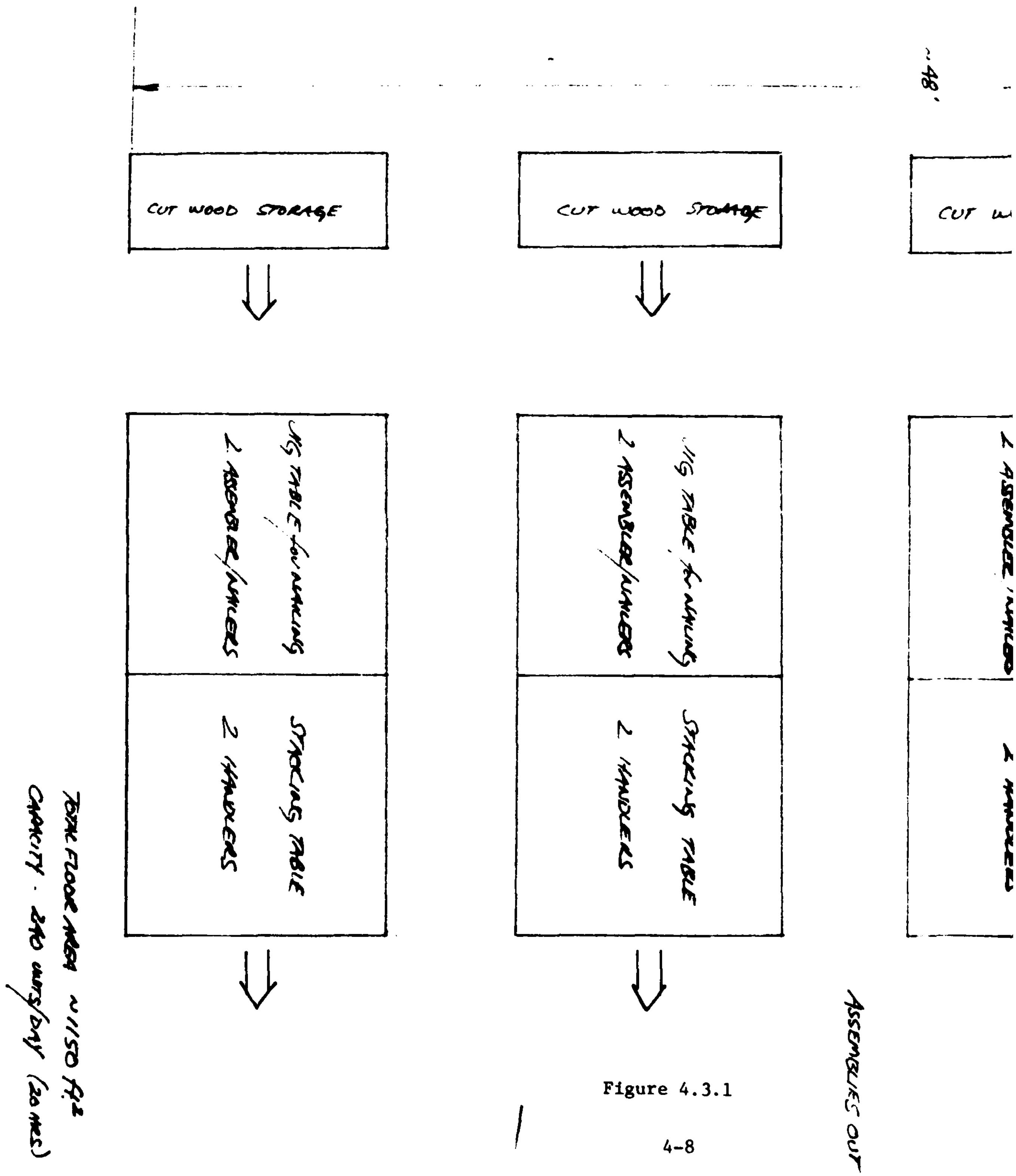

~48'
CUT WOOD STORAGE
CUT WOOD STORAGE
JIG TABLE for NAILING
2 ASSEMBLER/NAILERS
JIG TABLE for NAILING
2 ASSEMBLER/NAILERS
STACKING TABLE
2 HANDLERS
STACKING TABLE
2 HANDLERS
ASSEMBLIES OUT
TOTAL FLOOR AREA ~1150 ft²
CAPACITY · 240 units/DAY (20 HRS)

Figure 4.3.1

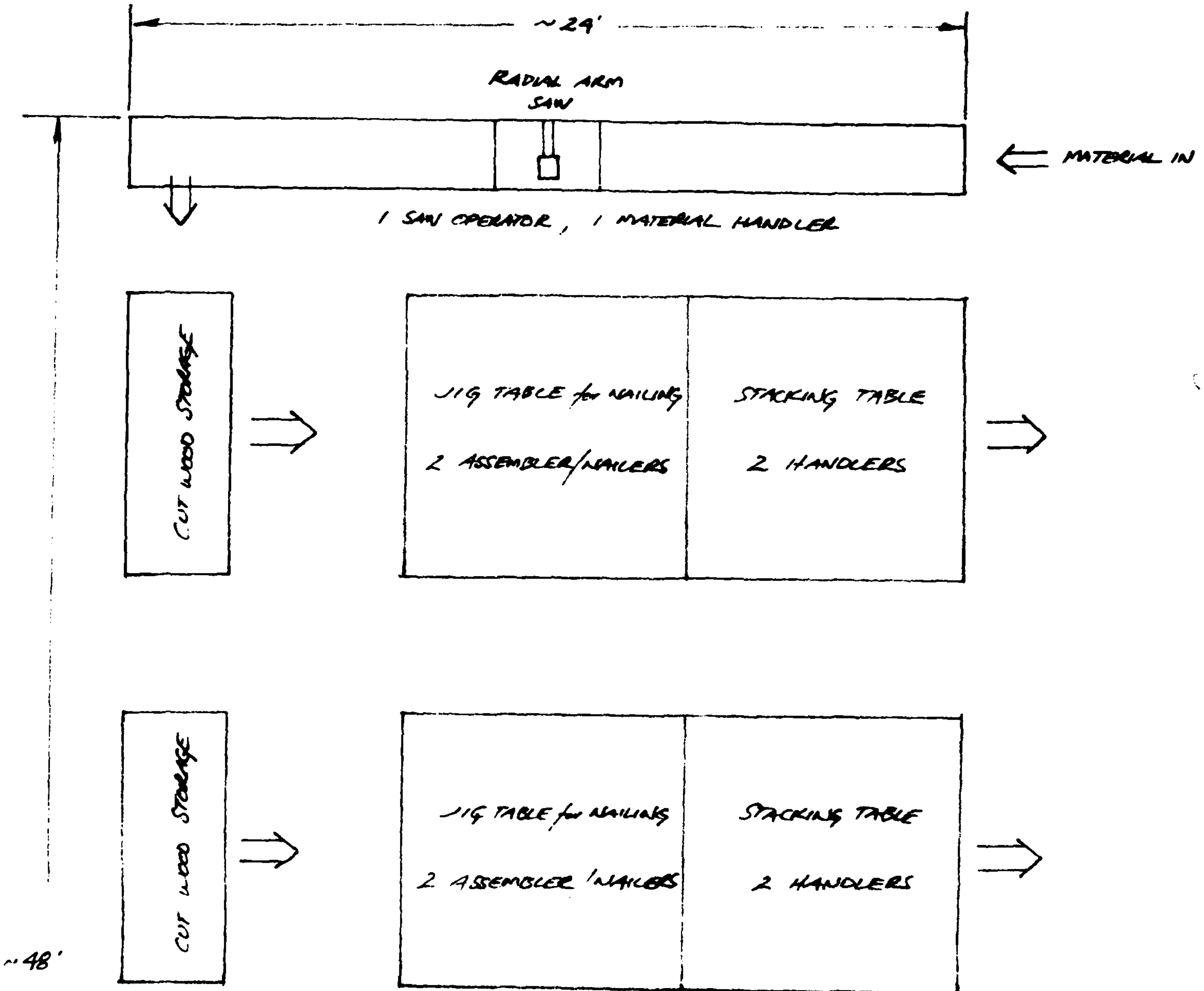

~24'
RADIAL ARM SAW
MATERIAL IN
1 SAW OPERATOR, 1 MATERIAL HANDLER
CUT WOOD STORAGE
JIG TABLE for NAILING
2 ASSEMBLER/NAILERS
STACKING TABLE
2 HANDLERS
CUT WOOD STORAGE
JIG TABLE for NAILING
2 ASSEMBLER/NAILERS
STACKING TABLE
2 HANDLERS
~48'

Table 4.3.2

Dunnage Shop Requirements for 155 MM Load

Dunnage Assemblies	Number of Areas Required	Bench or Table Area, ft^2	Estimated Floor Area, ft^2	Men/2-Shift
A. Side Fill Gates				
(1) Saw Areas	2	92 ft^2	138	8
(2) Assembly Areas	8	1,408	2,112	64
B. Separators				
(1) Saw Areas	2	36 ft^2	54	4
(2) Assembly Areas	8	240	360	32
C. Blocking and Beams				
(1) Long Saw Area	1	46	69	4
(2) Short Saw Areas	2	36	54	4
(3) Assembly Areas	4	704	1,056	32
Totals			3,843 ft^2	148 Men

Table 4.3.3

Dunnage Shop Requirements for 105 MM Load

Dunnage Assemblies	Number of Areas Required	Bench or Table Area, ft^2	Estimated Floor Area, ft^2	Men/2-Shift
A. Forward Strut				
(1) Saw Area	1	46	69	1
(2) Assembly Area	1	176	264	4
B. Blocks				
(1) Saw Areas	2	92	138	8
(2) Assembly Areas	4	704	1,056	32
C. Side Fill Gates				
(1) Saw Areas	2	92	138	8
(2) Assembly Areas	8	1,408	2,112	64
Totals			3,777 ft^2	117 Men

Table 4.4.1

Milan Time Study (10 Containers)

Operation	Actual Time (Hours)	Crew Size (Persons)	Total Actual Man-Hours	Work Projected for Requirement of Outlo 100 Containers/20-Ho	
				Man-Hours	Crew (Pers
A. Unload empty containers and position on pad.	5.5	2	11.0	110	5.
B. Overhead inspection.	2.5	2	5.0	50	2.
C. Prefabricate dunnage.	21.5	6	129.0	1,290	64.
D. Transfer M490 105 mm 24 rounds/pallet igloo to 30 ft. plant trailer to stuffing pad.	8.0	4	32.0	320	16.
E. Move front blocking from roadside storage to container, fabricate load bearing pieces, position assembly and return to roadside storage.	5.25	4	21.0	210	10.
F. Transfer pallets of M490 from plant trailer to container, install side dunnage and separator assemblies.	8.0	6	48.0	480	24.
G. Move rear blocking assembly from roadside storage to container, position assembly, fabricate struts.	6.0	4	24.0	240	12.
H. Load full containers onto bogies with 50K forklift transfer by crane to flat cars.	6.3	10	63.0	630	31.
I. Miscellaneous Activities.					
1. Unload and store metal corner posts.	1.0	2	2.0	20	1
2. Remove tie-down bar from rear corrugation to position metal corner posts.	2.5	2	5.0	50	2

ted for PALS
of Outloading
rs/20-Hour Day

Crew Size (Persons)	Equipment
5.5	50K Forklift
2.5	50K Forklift
64.5	Saws and Nailers
16.0	Forklift
10.5	?
24.0	Forklift?
12.0	Electric Power Saw
31.5	50K Forklift Mobile Rail Crane
1.0	?
2.5	Cutting Torch

Thus, it would appear that over 4,000 ft^2 of dunnage shop will be required with machines and material flow organized to permit the smooth flow of material and working space for a crew of about 60 to 75 men per shift for the two, ten-hour shifts.

4.4 MILAN TIME STUDY

A time study was made by personnel from the Martin Marietta Aluminum Sales, Inc., at the Milan Army Ammunition Plant, Milan, Tennessee in the Fall of 1979. The results of this study are presented in Appendix G. An analysis has been made of the study, in particular, the manhours (work measure) were projected from the 10 containers that were outloaded at Milan to 100 containers for a 20-hour day, the PALS requirement and the crew size were determined based upon this same projection. The results of the analysis of the Milan time study are presented in Table 4.4.1.

The activities in the Milan study included the unloading of empty containers and positioning these containers on a pad and also the overhead inspection of the containers. These two operations were not included in the DACS/MERADCOM study of the baseline system. Hence, we have deducted these two crews from the total crew requirement. As a result, instead of a crew of 170 persons required for each 10-hour shift, only 162 would be required. On this basis the cost for outloading 100 containers per 20-hour day for 25 days would be calculated as follows:

162 persons per shift x 2 shifts per day x 10 hours per shift x
25 days x $50 per person hour = $4,050,000

It is surprising how close this time study conforms to the DACS/MERADCOM study, namely, the labor cost for the baseline wooden system is $4,062,000 as compared with $4,050,000 for the Milan study. The labor cost for the baseline system for the DACS/MERADCOM study can be found in Table 2.7.6.

5.0 VISIT TO AUTOMATIC TRUCKLOADING SYSTEMS, INC., CARLISLE, PENNSYLVANIA, AND ABBOTT LABORATORIES, WAUKEGAN, ILLINOIS, TO WITNESS THE DOCK-MOUNTED ROLLER BED LOADER AND THE CABLE BED CONVEYOR SYSTEM FOR TRUCKS (SUBTASK 4)

5.1 VISIT TO ABBOTT LABORATORIES, WAUKEGAN, ILLINOIS

On 18 July 1980 a visit was made to Abbott Laboratories to observe the roller bed dock-mounted loader of ATS, Inc., in operation. The loader had been purchased by Abbott Laboratories and installed in January 1980. It was originally designed and built for Zenith Corporation and installed at Zenith. The Zenith load was about 30,000 pounds and the president of ATS, Inc., estimates that the unit had been cycled at Zenith for loading trailers about 2,000 times prior to its removal. The reason for its removal at Zenith was that they changed their package height and their shipping method from principally truck trailers to principally railroad vans and the railroad vans had too low a door opening for the ATS dock-mounted loader. There had been two other ATS dock-mounted loaders designed, built and installed. One of these was at the Pabst Brewery in Milwaukee. This particular loader became very unpopular with the fork-lift operators and apparently it became inoperable in this hostile environment. The other ATS dock-mounted loader was installed in Baltimore in a Weyerhauser corrugated container facility. The container operation was closed down; the disposition of this Baltimore dock-mounted loader is unknown at this time.

The chief engineer for shipping at Abbott Laboratories, Alex Banks, is very satisfied with the loader operation. They outload approximately five trailer loads per day, each trailer load approximates 40,000 pounds. Alex said if he had the volume he could outload many more trailers since the total load cycle is approximately 45 minutes and the outload cycle is only five to seven minutes of the total load cycle. In other words, the staging of the load by the forklift operators at the gantry end of the loader takes about 45 minutes, and the outloading of the total trailer load is the five to seven minutes. These times are not additive since the rear roller conveyor subsystem of the dock-mounted loader can be loaded by forklifts as the roller mat subsystem inserts the prestaged load into the trailer van. Abbott Laboratories is very pleased with the RAM characteristics of the loader. They have had no serious problems in the seven months of operation. They conduct a preventive maintenance program once a month on the loader, and the most trouble they have had thus far is with "o" ring leakage on an hydraulic pump. (Apparently the "o" ring was the wrong size.) They are pleased with the control system, and the controller has been programmed to fit their needs. It should be noted that the Abbott Laboratory loader is completely housed inside a building and is well protected from the elements.

The operation of the loader that we observed was as follows: The gantry moved the entire trailer load of shipping containers to the forward end of the roller mat until the load reached the shoehorn doors. The roller mat was then activated and moved the load into the trailer van. The trailer is raised about 2 inches above the dock level prior to loading by the hydraulic dock leveler. As the load is conveyed into the van with the roller mat conveyor, the interface between the trailer bed and the dock becomes even. Once the load is completely inserted into the trailer van, an hydraulic ram, which is permanently mounted to the dock structure, closes and pushes the load to compress it longitudinally into the trailer van while the roller bed is being retracted.

Based upon the observations at Abbott Laboratories, it is estimated that the cycle time for inserting the roller mat with a full ammunition load into a 20 foot ISO container and retracting the roller mat from the container would probably be two and one half minutes or less.

A most significant and important finding during the visit to Abbott Laboratories was the potential safety hazard of a person entrapped in the container during the loading operation. This apparently happened inadvertently to the chief engineer in transportation and warehousing. As a result there is only one operator who normally operates the controls of the dockside loader. If the designated operator is on leave, the chief engineer takes over. This safety hazard is considered serious (a relatively high probability of occurrence) and Abbott Laboratories have searched for an electro/mechanical/communication solution to the problem and so far have found none except to continue the management surveillance of the loading operation. We consider this safety hazard to be of such importance that we recommend to MERADCOM that an interlocked system be developed that will require two man operation of the controls during load insertion cycle of container loading. In other words, the controls for insertion would be on both sides of the roller bed mat requiring at least two individuals to coordinate their activities on the controls during load insertion. This should provide an acceptable management control over a potentially hazardous condition which is inherent to the operation of the dock-mounted loader.

5.2 VISIT TO AUTOMATIC TRUCKLOADING SYSTEMS, INC.

We met with the President of ATS, Inc., David W. Lutz, and toured their two manufacturing and assembly facilities in Carlisle, Pennsylvania.

The assembly facility with a high bay area is the Woodbridge Road facility, and the office and principal manufacturing shop is at Fifth and Penn Street. Initially, at the Woodbridge facility we observed the operation of the cable conveyor system in a 40 foot trailer. This system included four cables, or wire ropes, within the bed of the vehicle that slide on ultra high molecular weight (UHMW) polyethylene wear strips. The outer strands of the cable are flat. The cable floor is hydraulically driven by two hydraulic motors on each side which engage a triple roller chain which is used as a rack. There were four cables in this particular trailer. However, many of the trailers are equipped with as many as ten cables. During the loading procedure the forklift delivers from the dock pallet loads or slipsheet loads to the rear of the trailer. Once a row of pallets are spotted across the trailer, the cable bed is indexed forward to make room for the next row. There is no compaction technique except for the forklift itself.

The next demonstration at ATS, Inc., was the demonstration of their prototype dock-mounted loader and they had three large concrete slabs on each 41" x 42" pallet. The total load on the roller mat was approximately 36,000 pounds. They demonstrated the loading of a flat bed trailer with this 36,000 pound load and then they raked the load off onto the trailer. The operation of loading the flat bed and raking the load off was very smooth. This particular roller bed dock-mounted load is the prototype design comparable with the loader that was observed at Abbott Laboratories.

We then toured the facility of ATS, Inc. At the Woodbridge facility they were in the process of fabricating some heavy equipment trailers and at the Fifth and Penn Street facility they had a small assembly area in which they were building small lots of cable conveyor systems for trucks and trailers. The largest lot size that they have built thus far is 40. We would estimate that they probably have several hundred of these cable bed conveyor systems in operation, and we consider the cable conveyor system to be a production system as far as ATS, Inc., is concerned. However, we believe that the ATS dock-mounted loader is still in a prototype design stage since only four have been fabricated--each one different from the other.

According to the ATS, Inc., president, the current staff is at approximately 50 to 60% strength. However, we wish to point out they have demonstrated their engineering and manufacturing capabilities in support of their cable conveyor systems, and they are in the process of manifesting the same capabilities in support of their dock-mounted loaders which are still in a stage of transition. There are the opportunities for more sophisticated microprocessor or other solid state sequential controls that will contribute to the dock-mounted loader development in the future.

To observe the cable bed tractors, we drove to the Dolphin Distribution Services Warehouse which is a captive warehouse of the Hershey Chocolate Company. The warehouse is serviced from an input standpoint by three 40 foot Hershey tractor trailers which are equipped with the cable bed conveyor system. The distance between the Hershey manufacturing facility and the Dolphin Distribution Warehouse is approximately 16 miles. These tractor trailers have been in operation for approximately one year. There have been other (non-Hershey) tractor trailers in operation at the present time for as long as three years equipped with the cable conveyor system. The unloading of the trailer van took approximately 2 minutes and 50 seconds. It contained 40 pallets of approximately 1,000 pounds each for a total weight of 40,000 pounds. The load in this particular case was completely slipsheeted. In general, there is a mixed condition--some lift units are slipsheeted, other units are palletized. If they arrive slipsheeted, they are palletized for storage within the warehouse.

Each of these trailers contained eight cables. They have found that it is necessary to utilize a heavy duty steel plate on the dock surface onto which the trailer load is unloaded. A concrete surface is adequate from a friction standpoint but breaks up in a short period of time from the sliding forces of the load. Originally they went to 1/8" plate, but now they are in the process of installing 1/4" plate in the floor of the dock area of the warehouse.

Hershey stated since they have installed the cable conveyor system into their trailers, they are saving per trailer $5,000 a year in trailer damage which formerly had been caused by forklifts working in the trailer.

The RAM characteristics of the cable conveyor system that have been installed in the trailers appears to be adequate according to the president of ATS, Inc. The wear strips for some systems have been replaced on an annual basis, but on other systems have lasted thus far a minimum of three years.

6.0 Evaluate Data and Develop Findings (Subtask 5)

Subtask 5 is presented in the Findings of the Summary of the report. Subtasks 6 and 7 involved the writing of the draft final report with recommendations and the meeting at MERADCOM to discuss the government comments and finalize the report.

APPENDIX A

PROGRAM MANAGEMENT PLAN

FOR

CONTAINERIZED AMMUNITION DISTRIBUTION SYSTEM DEVELOPMENT

(CONVENTIONAL MUNITIONS)

DIRECTOR FOR TRANSPORTATION & WAREHOUSING POLICY

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE

[illegible] RESERVE AFFAIRS AND LOGISTICS (MRA&L)

MAY 1978

****

(JAN 80 — REV)

****

[illegible] APPENDIX [illegible] 1

SECTION 1

INTRODUCTION

1.0 INTRODUCTION.

1.1 BACKGROUND.

DOD planning for and shipment of conventional ammunition depends extensively on the use of commercial US Flag ships (i.e., containerships, RO-RO, SEABEE, LASH). By 1985, approximately 55% of the US Flag ships may be container capable ships with non-self-sustaining containerships comprising the majority of available shipping. Any future contingency operations of any magnitude or duration will require reliance on commercial containers and containerships. Since ammunition may account for 35 - 40% of the total tonnage, DOD must adapt its logistical distribution system to delivery of containerized ammunition from source to user.

This program integrates the efforts of the separate services to prevent duplication, assess timely progress and assure compatibility in the evolving system. This document reports progress and plans to all concerned. The Joint Intermodal Steering Group (JISG) provides guidance, resolves differences and directs corrective actions.

1.2 PURPOSE AND SCOPE.

The purpose of this plan is to provide system development guidance, tasks and milestones. Responsible services will direct, manage and complete assigned program tasks within the established system development framework. Detailed planning will be accomplished by participating activities in conformity with overall DOD guidance and direction.

1.3 PROGRAM GUIDANCE.

The following system shortfalls and points are provided as guidance in planning for and completion of assigned tasks:

1.3.1 Inability to distribute significant quantities of containerized ammunition to deployed forces in emergencies constitutes an unacceptable logistical support capability deficiency.

1.3.2 Safety is essential in ammunition distribution. Since containers are qualitatively safer to transport ammunition than traditional breakbulk methods, the services will develop loading, blocking, bracing, handling, and transport techniques and procedures for containerized ammunition. DOD will lead in obtaining required safety changes to laws and regulations.

1.3.3 Commercial equipment and services will be used when responsive to the military need (DODI 4500.37).

1.3.4 Ammunition will be containerized at source to the extent practicable. Stuffing containers at ammunition ports or terminals should be minimized during mobilization periods when emphasis is placed upon throughput capabilities. However, because terminal stuffing is sometimes cost effective in peacetime and to provide essential modal flexibility during mobilization, the ammunition ports or terminals should retain a capability to stuff/strip containers to meet ship availabilities and changes in mobilization requirements.

1.3.5 Containerization generally increases overall transportation efficiency, is more economical and streamlines ammunition distribution management.

1.3.6 Facilities construction or improvement and equipment acquisition or replacement programs will be designed to add the necessary container capability to satisfy contingency containerized ammunition throughput requirements. Improvements of existing breakbulk operations/facilities will be accomplished to the level necessary to satisfy contingency requirements.

1.3.7 System nodes and subsystems must be developed simultaneously and progressively within the overall CADS program.

1.4 PROGRAM DESCRIPTION.

The containerized ammunition distribution system will include a mix of commercial and DOD assets which function together to provide a source to user capability for handling, storing and transporting containerized and/or breakbulk ammunition shipments. The specific subsystems of the containerized distribution system follow:

1.4.1 Container

1.4.2 Container Control

1.4.3 CONUS Source

1.4.4 CONUS Line Haul

1.4.5 CONUS Ports of Loading

1.4.6 Ocean Surface Movement

1.4.7 Air Movement

1.4.8 Ports of Discharge

1.4.9 Overseas Line Haul

1.4.10 User

1.4.11 Common Equipment

1.4.12 Safe Transport of Munitions (STROM) Program (not treated as a separate subsystem).

1.5 PROGRAM APPROACH.

The required container capability will be added to the existing logistical system by the orderly completion of service projects and tasks identified in this program plan. To the maximum extent possible, the existing DOD equipment and off-the-shelf commercial equipment will be used to meet system hardware requirements.

1.6 SPECIFIC PROGRAM OPERATIONAL PERFORMANCE PARAMETERS.

OSD(MRA&L) specified that the containerized ammunition distribution system shall have as a goal the capability of meeting the following operational performance parameters:

1.6.1 Be capable of handling a sustained daily minimum of 1,000 containers in the system. (Note: Supported by a daily minimum CONUS port handling capability of 1,000 containers East Coast and 500 containers West Coast.)

1.6.2 Be routinely capable of handling either breakbulk cargo or container shipments.

1.7 PROGRAM OBJECTIVE.

The overall program objective is to develop an integrated source to user ammunition distribution system for delivery of ammunition by either container or breakbulk methods.

1.8 PROGRAM MAJOR TASKS.

1.8.1 Provide CONUS plants and depots a high volume capability for handling and shipping ammunition.

1.8.2 Assess current and projected capability of CONUS commercial carriers to transport ammunition from source to port of loading, and develop alternatives for improving transport capability when inadequacies are found.

1.8.3 Develop ocean terminal modernization and maintenance programs, establish project funding priorities and complete construction of projects.

1.8.4 Develop safety criteria and standards and any other special safety requirements for acquiring acceptable containerships for the transport of ammunition.

1.8.5 Insure routine and emergency ship acquisition contracts, programs and plans provide for safe ammunition ships.

1.8.6 Test and analyze responsiveness of the container acquisition mechanism to acquire and position containers at source stuffing points, and determine bogie assets to support trailer on flat car (TOFC) container movements.

1.8.7 Test and analyze the commercial container fleet and project safe container availability for ammunition shipments.

1.8.8 Compare ammunition tonnage requirements contained in contingency/wartime plans against current and projected container availability and container handling capability.

1.8.9 Develop restraint system(s), inspection handbook and operational procedures for shipment of ammunition in commercial containers.

1.8.10 Develop facility modernization improvement projects, establish project funding priorities, and complete construction of projects. These projects should be completed on an orderly, progressive basis concurrent with other system improvements.

1.8.11 Insure analysis of the current and projected capabilities of CONUS commercial carriers to position containers and to transport ammunition include assessment of the movements of essential civilian goods, general cargo supplies, as well as ammunition.

1.8.12 Develop and test specialized requirements and procedures for storage of containerized ammunition.

1.8.13 Determine procedures and methods which are technically and operationally feasible and economically acceptable that will prevent, or limit the effects of, explosive incidents in railcars and mass detonation of containerized munitions in ports and aboard ships.

1.8.14 Identify equipment requirements and develop and/or procure equipment necessary to handle and transport containerized ammunition.

1.8.15 Develop an air transport capability for movement of containerized ammunition.

1.8.16 Test and evaluate organizational suitability of ammunition supply units to operate effectively in handling, storing and transporting containerized ammunition.

1.9 PROGRAM FUNDING. Service funding programs for CADS development are shown at Figures 1-1, 1-2 and 1-3.

1.10 PROGRAM COMPLETION. FY83 is the target date for completion of the containerized ammunition distribution system, less completion of plant, depot and port facility modernization programs. The completion date(s) for these outstanding actions is contained in Section V and Section VII.

	PRIOR FY	FY80	FY81	FY82	FY83	FY84	FY85	FY86	TOTAL
RDTE	11.3	.3	.4	.5	1.2	1.2	1.5	1.5	17.9
OPA	234.1	62.9	69.8	72.8	65.8	44.5	54.7	-	604.6
MCA	.9	32.9	1.9		-	-	-	15.0[1]	50.7
OMA	3.4	-	-	-	-	-	-	-	3.4
MACI	2.0	-	-	-	-	-	-	-	2.0
TOTAL	251.7	96.1	72.1	73.3	67.0	45.7	56.2	16.5	678.6

[1] Long range MCA projection is $30.8M to modernize remainder of CONUS depots.

(As of 11 JAN 80)

FIGURE 1-1. ARMY CONTAINERIZATION FUNDING PROGRAMS ($ IN MILLIONS)

	PRIOR FY	FY80	FY81	FY82	FY83	FY84	FY85	TOTAL
RDT&E(6.2)	.70	.12	.12	.12	.12	.12	.12	1.42
OPN								
Vehicles(NAVFAC)	-	-	-	-	.67	-	-	.67
MHE(NAVSUP)	-	-	.08	-	.40	-	-	.48
MILCON(less P&D costs)								
WPNSTA Concord	-	-	-	-	6.60	8.50		15.10
WPNSTA Earle	-	-	-	68.19	26.38	46.36	26.40	167.33
TOTAL	.70	.12	.20	68.31	34.17	54.98	26.52	185.[illegible]

(As of 11 Feb 80)

FIGURE 1-2 NAVY AMMUNITION CONTAINERIZATION FUNDING ($ IN MILLIONS)

FUNDING PROGRAMS FOR CONTAINER HANDLING FY 80-85

CATEGORY & EQUIP TYPE	PRIOR FY	FY 80	FY 81	FY 82	FY 83	FY 84	FY 85	TOTAL
OTE (Research & Dev)	.5							.5
PAF (Other Procurement)								
Elevator Loader		3.4						3.4
Wide Body Mobile Loader		1.2	1.3	5.5				8.0
40K Loader	7.7							7.7
25K Loader		6.2	3.2					9.4
Container Lift Truck				3.6				3.6
Adapter Pallets								
CAF (Mil Constr)								
Bridge Crane 35 Ton	1.0							1.0
TOTAL	9.2	10.8	4.5	9.1				33.6

(As of 21 Jan 80)

FIGURE 1-3. AIR FORCE CONTAINERIZATION FUNDING PROGRAMS ($ IN MILLIONS)

APPENDIX B

DEPARTMENT OF THE ARMY
HEADQUARTERS US ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND
5001 EISENHOWER AVE., ALEXANDRIA, VA. 22333

DRCDE-DS

5 OCT 1979

SUBJECT: LOA for a Prestaged Ammunition Loading System

Commander
US Army Mobility Equipment
Research and Development Command
ATTN: DRDME-U
Fort Belvoir, VA 22060

1. The proposed LOA has been forwarded to TRADOC as a DARCOM approved requirement.

2. Because a specific technical approach has not been identified, it is requested that a feasibility and applicability study of proposed concepts be made by MERADCOM. At the conclusion of this study, request that a meeting be held to review the findings to determine whether continued development is justified. Representatives of various elements of the Army that would be involved in the use of the system, i.e., supply, transportation, producer personnel, as well as this office and DRCMM-CS, should be invited.

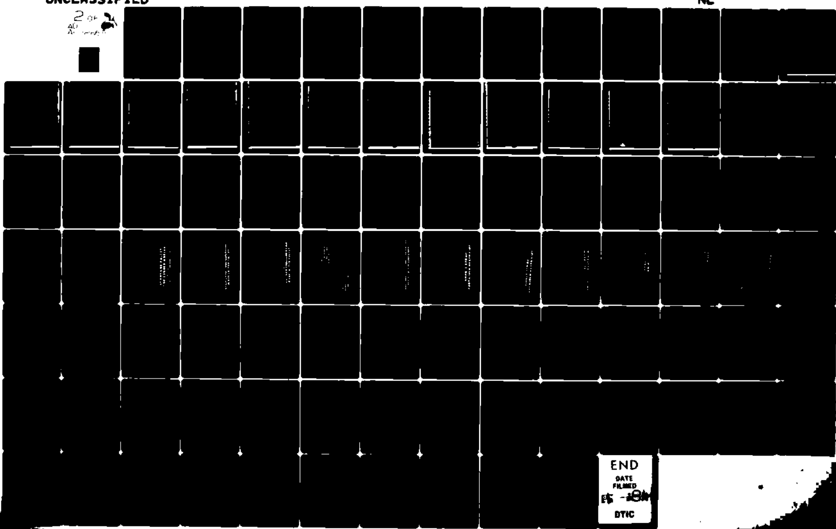
FOR THE COMMANDER:

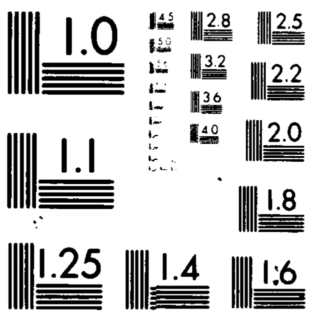
Ashby F. Collins

ASHBY F. COLLINS
Colonel, GS
Development Manager for
Armor/Infantry
Systems Development Office
Development & Engineering Dir

AD-A092 668 LITTLE (ARTHUR D) INC CAMBRIDGE MA F/G 19/1
TECHNOLOGY ASSESSMENT OF THE DACS/MERADCOM PRESTAGED AMMUNITION--ETC(U)
AUG 80 R H BODE, J S HOWLAND DAAK70-79-D-0036

UNCLASSIFIED NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

DEPARTMENT OF THE ...MY
HEADQUARTERS US ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND
5001 EISENHOWER AVE., ALEXANDRIA, VA. 22333

26 SEP 1979

DRCDE

SUBJECT: Proposed LOA for a Prestaged Ammunition Loading System

Ft. Belvoir, VA

Commander
US Army Training and
Doctrine Command
ATTN: ATCD-S-L
Ft. Monroe, VA 23651

1. The subject proposed LOA is a DARCOM approved requirement. The Defense Ammunition Center and School is the designated user representative for ARRCOM and DESCOM, and has concurred (Incl 1).

2. The proposed LOA is forwarded for your indorsement and publication (Incl 2, original plus three copies).

FOR THE COMMANDER

2 Incl
as

Edmund A. Thompson

EDMUND A. THOMPSON
Colonel, GS
Development Manager for
Individual Soldier/Training Devices
Systems Development Office

US ARMY DEFENSE AMMUNITION CENTER AND SCHOOL
SAVANNA, ILLINOIS 61074

REPLY TO ATTENTION OF

SARAC-DEV

17 JUL 1979

SUBJECT: Draft Letter of Agreement (DLOA) For the Investigation of a Prestaged Ammunition Loading System (PALS)

Commander
US Army Materiel Development & Readiness Command
ATTN: DRCDE-E
5001 Eisenhower Avenue
Alexandria, VA 22333

1. References:

a. Letter with Inclosure, DRDME-UP, 6 Jun 79, SAB (Incl 1).

b. First Ind, DRSAR-TM, 5 Jul 79, to letter, SARAC-DEV, 27 Jun 79, SAB (Incl 2).

c. Message, DRSDS-SPP, 111605Z Jul 79, SAB (Incl 3).

2. The DLOA (Inclosure to Reference a) including appropriate cost assessment is being forwarded for review and concurrence in order to provide funding for the project of reducing the turn-around time of commercial containers at ammunition depots during a contingency condition.

3. The Defense Ammunition Center and School (DACS) is designated as the user representative for the ARRCOM/DESCOM communities and inclosed are references b and c indicating formal concurrences of these commands.

4. For further information or assistance, contact the undersigned at autovon 585-8801.

FOR THE DIRECTOR:

3 Incl
as

Donald L. Willis
for WILLIAM F. ERNST
Acting Chief, Logistics Engineering Office

CF:
Cdr, MERADCOM (DRDME-UP) w Incls 2 & 3
L ~~Cdr,~~ DARCOM (DRCPM-CS) w Incls 2 & 3
Cdr, ARRCOM (DRSAR-TM) w Incl 3
Cdr, DESCOM (DRSDS-SPP) w Incl 2

Incl 2

LETTER OF AGREEMENT

FOR

THE INVESTIGATION OF A PRESTAGED AMMUNITION LOADING SYSTEM (PALS)

1. NEED

a. The need exists to improve the turn-around time of large cargo containers at ammunition depots during a contingency condition.

b. The two approved ammunition restraint systems currently available for containerized ammunition shipments in commercial 20-foot intermodal freight containers may require up to 2 hours for loading and securing. Under contingency conditions, a system is required which will reduce the loading and securing time for ammunition (reference DOD approved Program Management Plan for Containerized Ammunition Distribution System Development for Conventional Munitions dated May 1978).

c. This concept will not necessarily become a principal loading and securing system but is intended to enhance the movement of ammunition during the early stage of a contingency.

d. Catalog of Approved Requirements Document Number:

2. OPERATIONAL CONCEPT

a. The PALS will be employed in a role similar to the current system for restraining ammunition in commercial 20-foot cargo containers. Ammunition will be presecured to the system and rapidly inserted and secured in the container at the ammunition depot. The container, with its secured cargo, will then move through the supply distribution system as any other containerized load. At the far shore distribution point, the ammunition will be removed by conventional MHE and the PALS will be returned to CONUS as retrograde cargo.

b. Mission Profile (See Annex A).

3. SYSTEM DESCRIPTION

a. The PALS design goal is to reduce the time of commercial container turn-around at the ammunition depot.

b. To achieve the design goal, the system shall incorporate three basic principles; the first is compatibility with existing MHE in the retail system (OCONUS Theater of Operation), the second is minimum modification to the container, and the third is the system shall not adversely impact the unloading operations in the field.

c. The PALS should consist of a simple device on which the ammunition load is assembled and secured. The load must be consolidated into a controllable mass. Simple means must be provided for container loading and for securing the device inside the container when the empty container arrives at the depot. PALS must provide the restraint necessary to meet Association of American Railroads (AAR) and Coast Guard (CG) regulations for the shipment of ammunition. The system must be compatible with existing MHE in the retail system. Any modification, alterations or adjustments to wholesale MHE must be minimized.

d. RAM characteristics are not appropriate for the PALS. The passive nature of the PALS is such that its reliability is due to its structural strength. It would not be cost effective to perform extensive life testing to demonstrate the inherently high reliability of the PALS when less costly structural strength testing will yield equivalent results.

e. Nuclear survivability is not a potential requirement for this proposed developmental item. Further substantiation and rationale for omitting nuclear survivability will be provided in the requirements document.

f. The PALS will be transportable to and within the theater by highway, rail, marine, and air transport.

4. PROSPECTIVE OPERATIONAL EFFECTIVENESS AND COST

a. The PALS design goal is to reduce the time of commercial container turn-around at the ammunition depot.

b. Although the PALS is expected to cost more than the two existing restraint systems its effectiveness in the early stages of a contingency makes this cost differential acceptable.

c. Since the PALS will be a contingency system, the only limit on hardware cost would be the cost for a new, fully restrained ammunition MILVAN container.

d. The prospective upper limit on unit cost is $3,500 FY79 constant dollars (based on the current cost of a fully restrained MILVAN container).

5. SYSTEM DEVELOPMENT

a. Operational Employment Plan. The following critical issues will be addressed in OT I:
DT I

(1) Can ammunition loads be effectively restrained to the PALS platform?

(2) Can the PALS platform with restrained ammunition load be transferred to, loaded into and secured in commercial 20-foot cargo containers?

(3) Can the PALS constrained cargo be unloaded u ler field conditions?

(4) Can the PALS meet AAR and CG regulations for the safe shipment of ammunition in commercial cargo containers?

(5) Determine the impact on the logistic support system.

(6) Determine the effectiveness of the training package.

(7) Determine the impact on the personnel required to support the system.

b. Technical Plan. Overall technical risk for this development is estimated to be medium. The following critical issues will be addressed before or during DT 1:

(1) Determine the optimum configuration of the PALS platform. (technical risk: medium)

(2) Determine the optimum method for restraining the ammunition load to the PALS platform. (technical risk: medium)

(3) Determine the method for transferring the PALS platform to the container. (technical risk: low)

(4) Determine the most effective method for restraining the PALS platform in the container. (technical risk: medium)

(5) Determine the impact on unloading in the field. (technical risk: low)

(6) Determine the optimum place to prestage the load. (technical risk: low)

(7) A Producibility Engineering and Planning program will be established in accordance with AR 70-1 as early as possible in the R&D program and status addressed at all In-Process Reviews.

c. Plan for Logistic Support. The material developer will insure that the PALS is designed in such a manner which will allow it to be supported logistically in the same manner used to support the existing ammunition restraint systems.

d. Plan for training. The PALS training package will be designed, conducted and validated so that personnel now engaged in containerized ammunition operations will be able to successfully perform all functions to make the system operationally effective.

e. Personnel Support Plan. The material developer will attempt to reduce the number of personnel required to perform the outloading functions in the containerized distribution of ammunition as compared to those required to support the present outloading methods.

·DULES AND MILESTONES

· following is an estimated program schedule:

LOA approved	4Q FY79
Conduct COEA	3Q FY80
Complete Concept Formulation	4Q FY80
DT/OT I	Complete 3Q FY82
Update COEA	4Q FY82

·DING

Advanced Development (6.3B) ($000s)

Range:	LOW	HIGH
Constant (FY79)	$ 555	$ 672
Inflated (Then Year)	$ 639	$ 774

Most Likely Funding Profile:	FY80	FY81	FY82	FY83	TOTAL
Constant (FY79)	209	202	131	42	584
Inflated (Then Year)	226	233	160	54	673

Quantity of Prototype - 6

Sunk Costs (Actual Dollars) (Excluded from Paragraph a):
R&D - $198

[illegible] COST ANALYSIS DIVISION
CECDC Control #: 6212 Validation Level: III
Validated: 4 June 79 Expires: 4 June 80
Analyst: MASSAR Phone #: 4-4672
Supervisor: Robert C. Hunt Remarks:

b. Engineering Development (6.4)

Range:	LOW	HIGH
Constant (FY79)	$ 924	$ 1119
Inflated (Then Year)	$1253	$ 1517

Most Likely Funding Profile:	FY83	FY84	FY85	FY86	TOTAL
Constant (FY79)	443	215	288	27	973
Inflated (Then Year)	571	293	414	41	1319

Quantity of Prototype - 10

c. Unit Flyaway Cost (Constant FY79 Dollars)

ITEM	UNIT COST	QUANTITY	LEARNING SCOPE
PALS	$2592	1000	100%

Inflation has been incorporated in accordance with DARCOM Inflation Guidance provided on 17 May 1979.

MERADCOM COST ANALYSIS DIVISION
CECDC Control # 6212 Validation Level: III
Validated: 4 June 79 Expires: 4 June 80
Analyst: Massar Phone #: 4-4672
Supervisor: Robert P. Hunt Remarks:

Stan R. Sheridan
STAN R. SHERIDAN
Major General, USA
Director for
Development and Engineering

ANNEX A

MISSION PROFILE

PRESTAGED AMMUNITION LOADING SYSTEM (PALS)

THREAT

Weapons Posing Threat to System	Theater (Port)	Corps Area	Division Area
Artillery	——	X	X
Ground-to-Ground Missiles	X	X	X
Bomber Aircraft	X	X	X
Fighter Aircraft	X	X	X
Saboteurs	X	X	X

TASK

a. The PALS will be employed in a role similar to the current system for restraining ammunition in commercial cargo containers. Ammunition will be presecured to a system platform at the CONUS ammunition depot. At the time of contingency this prestaged load will be transferred into a commercial cargo container and secured for transport. The container, with its secured cargo, will then move through the supply distribution system as any other containerized load of ammunition. At the far shore distribution point, the ammunition will be removed by conventional MHE and the PALS returned to CONUS as retrograde cargo. The PALS will be subject to the same threat as any other containerized shipment of ammunition.

b. The system will operate in a closed loop from CONUS ammunition depot to OCONUS ammunition distribution point and return to CONUS for reuse.

c. The PALS will be a contingency system for initial rapid fill of the ammunition pipeline. Follow-on shipments will be made using both a mix of conventional systems and PALS.

COST ASSESSMENT (LOA)

Summary of estimated Research and Development Costs in constant FY79 and inflated (then year) dollars ($K-Thousands):

a. ADVANCED DEVELOPMENT (6.3)

Range:	LOW	HIGH
Constant (FY79)	$ 555	$ 672
Inflated (Then Year)	$ 639	$ 774

Most likely funding profile:

	FY80	FY81	FY82	FY83	TOTAL
Approved Program	0	0	0	0	0
Estimate (Constant)	209	202	131	42	584
Estimate (Inflated)	226	233	160	54	673

Note 1: Quantity of Prototypes(s) 6 .
Note 2: Sunk Costs (excluded from paragraph a).
R&D (Actual) $ 198 . R&D (Constant) $ 252 .

b. ENGINEERING DEVELOPMENT (6.4)

Range:	LOW	HIGH
Constant (FY79)	$ 924	$ 1119
Inflated (Then Year)	$ 1253	$ 1517

Most likely funding profile:

	FY83	FY84	FY85	FY86	TOTAL
Approved Program	0	0	0	0	0
Estimate (Constant)	443	215	288	27	973
Estimate (Inflated)	571	293	414	41	1319

Note 3: Quantity of Prototype(s) 10 .

c. UNIT FLYAWAY COST. Broad based estimate of unit flyaway cost expressed in constant FY79 dollars.

ITEM	UNIT COST	QUANTITY	LEARNING SLOPE
PALS	$ 2592	1000	100%

Note 4: Inflation has been incorporated in accordance with Letter, DRCCP-ER, subject: Inflation Guidance provided on 17 May 1979.

Note 5: Source document for cost is Abbreviated BCE dated 29 May 1979.

MIRADCOM COST ANALYSIS DIVISION
[illegible] Control # 6212 Validation Level: III
Validated: 14 Jun 79 Expires: 1 Jul 80
Analyst: [illegible] Phone # 44672
Supervisor: [illegible] Remarks:

PRESTAGED AMMUNITION LOADING SYSTEM (PALS)
BASELINE COST ESTIMATE (BCE)
COST ELEMENT DETAIL FOR LOA/ODP
(FY 79 CONSTANT DOLLARS, $000s)

ADVANCED DEVELOPMENT (6.3)		PRIOR YR	CURR YR	FY 80	FY 81	FY 82	FY 83	FY 84	TOT
1.0	Research and Development	252		209	202	131	42		83
1.01	Development Engineering	252		174	126	97	42		69
1.02	PEP			-	-	-	-		-
1.03	Tooling			-	-	-	-		-
1.04	Proto Mfg (Incl Spares)			35	57	15	-		10
1.05	Data			-	9	4	-		1
1.06	System Test & Eval			-	10	15	-		2
1.07	System/Project Mgt			-	-	-			
1.08	Training			-	-	-			
1.09	Facilities			-	-	-			
1.10	Other			-	-	-			
1.1X	(No. of Prototypes)				(4 ea)	(2 ea)			
ENGINEERING DEVELOPMENT (6.4)		FY83	FY84	FY85	FY86				
1.0	Research and Development	443	215	288	27				97
1.01	Development Engineering	188	108	161	27				4
1.02	PEP	-	71	127	-				1
1.03	Tooling	-	-	-	-				
1.04	Proto Mfg (Incl Spares)	203	-	-	-				2
1.05	Data	52	-	-	-				
1.06	System Test & Eval	-	29	-	-				
1.07	System/Project Mgt	-	-	-	-				
1.08	Training	-	7	-	-				
1.09	Facilities	-	-	-	-				
1.10	Other	-	-	-	-				
1.1X	(No. of Prototypes)	(10 ea)							
FLYAWAY COSTS									
2.0	Investment								25
2.011	Initial Nn Facilities								
2.021	Manufacturing								25
2.022	Recurring Engineering								
2.023	Sustaining Tooling								
2.024	Quality Control								
2.05	Other Production								
2.03	Engineering Changes								
2.04	System Test & Eval								
2.06	System/Project Mgt								

MERADCOM COST ANALYSIS DIVISION
CECDC Control # [illegible] Validation Level: III
Validated: [illegible] Expires: [illegible]
Analyst: [illegible] Phone: [illegible]
Supervisor: [illegible] Remarks:

APPENDIX C

SARAC-DEV

SUBJECT: Minutes of Prestaged Ammunition Loading System (PALS) Joint Working Group Meeting

SEE DISTRIBUTION

1. A Joint Working Group (JWG) Meeting was held on 12-13 Mar 80 at the US Army Defense Ammunition Center and School (USADACS). The attached Minutes of the Meeting are forwarded for your information and retention.

2. In conjunction with the development of PALS, USADACS has initiated a series of static load tests on various alternate configurations for the front and rear blocking assemblies (gates) of the restraint system for commercial intermodal containers. Based on the initial results of these tests, it appears that suitable modification to certain existing wooden dunnaging components could reduce outloading costs. Full scale tests, required to verify the feasibility of such modifications, will be conducted concurrent with the final PALS evaluation.

3. A meeting is being scheduled at MERADCOM for the purpose of briefing DRCDE-DS and DRCMM-CS on the current status of the PALS Program, including the JWG decision to pursue the Automatic Truckloading System (ATS) concept.

FOR THE DIRECTOR:

1 Incl
as

WILLIAM F. ERNST
Chief, Evaluation Division

DISTRIBUTION:

Commanders
ARRCOM, Rock Island, IL 61299
DRSAR-TM
DRSAR-LEP

SARAC-DEV
SUBJECT: Minutes of Prestaged Ammunition Loading System (PALS) Joint
Working Group Meeting

Commanders
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Brooks & Perkins, Inc (Mr. R. Vermeulen/Mr. J. Bomberger/Mr. B. Herrick)
12633 Inkster Rd, Livonia, MI 48150
Day & Zimmerman (Mr. J. Gilpin/Mr. J. Ponce) Parsons, KS 67357
Baker Materiel Handling (Mr. B. Heiser) Cleveland, OH 44108

MINUTES OF MEETING

SUBJECT: Technical Meeting to Evaluate and Select for Development of a Prestaged Ammunition Loading System (PALS)

AGENDA:

The meeting was divided into two distinct sessions; the first day was devoted to presentations as listed on the attached Agenda (Incl 1). Mr. Rudy Messerschmidt, MERADCOM, presented the opening remarks and served to focus the groups' attention on those specific objectives that were expected to be accomplished during the course of this 2 day session.

Three significant presentations were provided which are listed below:

1. "Power Low-Lift Truck", Baker Materiel Handling - Bob Heiser.
2. "Prestaged Platform Concepts", Brooks & Perkins - Ronald Vermeulan.
3. "Dock Mounted Container Loader Concept", Automatic Truckloading Systems, Inc - David Lutz.

The second day (morning session) consisted of a group discussion, without any industry representatives being present. This served to provide an open discussion on the various PALS concepts that were presented and offered an opportunity for each individual to present his technical assessment. A written summary sheet was then turned in by each individual which served as a written document that could weigh each system and establish a future course of action.

PERTINENT COMMENTS:

1. One significant point addressed the fact that 100 containers per depot per day, or 1,000 containers per day for 30 days, is a basic PALS requirement and that any significant change to increase this quantity would greatly impact the handling/unloading capability in the field.

2. The present approved restraint methods are only approved for "cushioned" flatcars. There is concern that in the event of a contingency, there may be a shortage of COFC/TOFC rail equipment (rolling stock).

3. When using the platform concept for trailer on flatcar (TOFC), recompute and verify that the composite center of gravity (CG) is within the allowable limits for certification by the Association of American Railroads (AAR).

4. The group was in complete agreement that the "ATS" system offered a distinct advantage because it is readily adaptable to both commercial as well as MILVAN containers.

5. It is entirely possible that the prestaged platform which was included into the Brooks & Perkins concept could have an interference problem at the 8'-6" container door opening with the present loading/unloading procedures when handling double tiered unit loads that exceed 40 inches in height.

6. The "ATS" system offers a distinct advantage at the port by enabling break bulk shipments of ammunition arriving by railcar to be unstuffed and rapidly reloaded into containers for eventual movement by container ships.

7. The Brooks & Perkins prestage platform concept could serve to improve the airlift capability of moving ammunition during the early stages of a contingency, and thereby enhance rapid deployment.

8. It was suggested that the entire PALS effort should be coordinated with the depot/plant modernization programs.

9. The dunnaging problem remains a medium risk technical problem that should be resolved concurrent with the development of the "ATS" system.

10. An economic analysis should be performed as soon as possible to enable justifying one or both systems.

11. The "ATS" concept could be put into use at the ammunition plants on an immediate basis.

12. It appears evident that a viable system can be developed that will reduce the container outloading time/turn-around time at the load-out point.

13. The technical problems that surfaced during the course of discussion appeared to be minimum risk and not beyond the state-of-the-art.

CONCLUSIONS:

1. The working group agreed that a continuing effort on both the Prestaged Platform Concept and the Dock-mounted Container Loading System (ATS) is encouraged.

2. It was also concluded that the PALS platform concept should be considered as a viable method for rapidly deploying ammunition during the early stages of mobilization provided a satisfactory handling capability is available to field forces.

RECOMMENDATIONS:

1. The PALS JWG concluded the meeting with two recommendations:

a. First, that the PALS-Automatic Container Loader Concept (ATS) be expeditiously developed and tested (6.3) for rapidly outloading ammunition in 20 ft freight containers at CONUS depot, plant and port facilities in a timeframe consistent with DARCOM mobilization plannings.

b. Second, that a new PALS LOA be prepared to include rapid deployment of prestaged ammunition loads in the earliest stages of mobilizing contingency forces.

MEETING ATTENDANCE LOG

SUBJECT: PRESTAGED AMMUNITION LOADING SYSTEM (PALS) MEETING

MEETING DATE: 12 - 13 Mar 80

ATTENDEE	ORGANIZATION, ADDRESS, AND PHONE
Bob Heiser (216) 761-5352	Baker Materiel Handling Cleveland, OH 44108
James R. Bomberger (313) 522-2000	Brooks & Perkins 12633 Inkster Rd. Livonia, MI 48150
Bill Herrick (313) 522-2000	Brooks & Perkins 12633 Inkster Rd. Livonia, MI 48150
William F. Ernst AV 585-8711 (815) 273-8711	Director US Army Defense Ammo Center & School ATTN: SARAC-DEV Savanna, IL 61074
John W. Dreger AV 585-8751 (815) 273-8751	Director US Army Defense Ammo Center & School ATTN: SARAC-DEV Savanna, IL 61074

MEETING ATTENDANCE LOG

SUBJECT: PRESTAGED AMMUNITION LOADING SYSTEM (PALS) MEETING

MEETING DATE: 12 - 13 Mar 80

ATTENDEE	ORGANIZATION, ADDRESS, AND PHONE
MAJ Al Hogsett (representing DESCOM) AV 585-8631	Commander Savanna Army Depot Activity ATTN: SDSLE-VM Savanna, IL 61074
David L. Lutz	Automatic Truckloading Systems, Inc. P.O. Box 810 Carlisle, PA 17013
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John Gilpin (913) 421-4000	Day & Zimmerman Parsons, KS 67357
Joe Ponce (913) 421-4000	Day & Zimmerman Parsons, KS 67357

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SUBJECT: PRESTAGED AMMUNITION LOADING SYSTEM (PALS) MEETING

MEETING DATE: 12 - 13 Mar 80

ATTENDEE	ORGANIZATION, ADDRESS, AND PHONE
CW3 Francisco G. Vicuna AV 746-1473/1676	Commandant US Army Missile & Munitions Center & School ATTN: ATSK-CD-MD Redstone Arsenal, AL 35803
Grayson G. Morrissett AV 687-2448/4723	Commander USALOGC ATTN: ATCL-MS Ft. Lee, VA 23801
Ernest Proudman AV 284-8800	Commander US Army Materiel Development & Readiness Command, ATTN: DRCMM-CS Alexandria, VA 22333
LTC Lyman J. Walker II AV 793-4905	Commander US Army Armament Materiel Readiness Command ATTN: DRSAR-TM Rock Island, IL 61299
Rudolph Messerschmidt AV 354-5311	Commander US Army Mobility Equipment Research & Development Command, ATTN: DRDME-HM Ft. Belvoir, VA 22060

MEETING ATTENDANCE LOG

SUBJECT: PRESTAGED AMMUNITION RESTRAINT SYSTEM (PALS) MEETING

MEETING DATE: 12 - 13 Mar 80

ATTENDEE	ORGANIZATION, ADDRESS, AND PHONE
Gayle T. Zajicek AV 585-8751 (815) 273-8751	Director US Army Defense Ammo Center & School ATTN: SARAC-DEV Savanna, IL 61074
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Rudolph Messerschmidt AV 354-5811	Commander US Army Mobility Equipment Research & Development Command, ATTN: DRDME-HM Ft. Belvoir, VA 22060

MEETING ATTENDANCE LOG

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APENDIX D

TABLE 4-3. .DARCOM MAGAZINE STORAGE

Depot	Igloo 80' Single Door	Igloo 80' Double Door	80' Stradley	Igloo 60' Single Door	Igloo 60' Double Door	Igloo 40' Single Door	Total Earth Covered	Std Above Ground
Anniston	132 S.A.	100 L.A.	478 L.A.	475 S.A. 224 L.A.		6 S.A.	1415	6
Blue Grass	600 S.A.	100 L.A.	0	200 S.A.		2 S.A.	902	12
Letterkenny	596 S.A.	104 L.A.	0	200 S.A.		2 S.A.	902	11
Navajo	141 S.A. 459 L.A.	0	0	185 S.A. 181 L.A.		2 L.A.	801	12
Pueblo	450 S.A. 150 L.A.	120 L.A.	0	50 S.A. 150 L.A.		2 S.A.	922	3
Red River	261 S.A. 116 L.A.	23 L.A.	0	206 S.A. 94 L.A.		2 S.A.	702	18
Savanna	0	0	8 L.A.	383 S.A.	23 L.A.	23 S.A.	437	100
Seneca	100 L.A.	17 L.A.	0	390 L.A.	10 L.A.	2 L.A.	519	8
Sierra	500 S.A. 68 L.A.	32 L.A.	0	100 S.A. 100 L.A.		2 S.A.	802	12
Tooele	140 S.A. 600 L.A.	100 L.A.	0	200 L.A.		2 S.A.	1042	12
Umatilla	104 S.A. 224 L.A.	30 L.A.	0	309 S.A. 332 L.A.		2 S.A.	1001	14
Ft. Wingate	100	80 L.A.	0	550		2 S.A.	732	12
TOTALS	4745	702	486	4162	33	49	10,177	244

S.A. - Small Igloo Apron (7' x 9') Elev 12" to 36" above roadway.
L.A. - Large Igloo Apron (12' x 15') ground level.

McAlister
Hawthorn.
Crane

EX-NAVY,
Combined PLANT/DEPOT
Facilities

TABLE 4-4. MAGAZINE CHARACTERISTICS

				Doors			
				Single		Double	
Magazine Type	Length, feet	Width, feet	Height, feet	Width, inches	Height, inches	Width, inches	Height, inches
Igloo	80, 60 or 40	26.5	12.75	48	90	90	90
Stradley	80, 60 or 40	25.0	14.0			144 120	126 114
Standard Above Ground	215.7	48.7	14.1	94	119		

Magazine Storage Facilities

ARRCOM

Plant	Earth Covered						
	50' x 100'	32' x 44'	25' x 80'	25' x 40'	25' x 20'	Other	Total
Crane	257 (LC)* 224 (PC)	3 (WT)	1021 (AT)	20 (BT)	87 (FC)		
Total	481	3	1021	20	87		1612
Hawthorne	332 (EC)	8 (WT)	1088 (AT) 501 (AC) (167-Triple)	84 (BT)	112 (FC)	3-15' x 50' 2-15' x 20'	
Total	332	8	1589	84	112	5	2130**
McAlester	323 (PC)		780 (AT) 360 (LC) (120-Triple)	12 (BT)	128 (FC)	Corbetta 52' dia 660 (220-Triple)	
Total	323		1140	12	128	660	2263
Total - ARRCOM Plants	1136	11	3750	116	327	665	6005

*Magazine Type & Capacity Letters - 1st digit: A - High Explosive (HE); B - HE; D - 52' Dia Corbetta, Corbetta, HE; E - Black Powder; F - Fuze & Detonator; L - Powder; P - Projectiles/Fixed Ammo; W - HE.

** Hawthorne also has 92 aboveground magazines as follows: 48 - 50' x 100', 14 - 50' x 160', 30 - 50' x 200'

APPENDIX E

PALS

COMPARATIVE EQUIPMENT COST PER DEPOT

	ITEM	UNIT COST	WOODEN SYSTEM		PLATFORM SYSTEM		ATS SYSTEM	
(1)	50K RT CONTAINER HANDLER	162K	(2)	324	(2)	324	(1)	162
(2)	4K FORKLIFT (ELECT)	20K	(12)	240		---	(4*)	80
(3)	4K FORKLIFT (GED)	17K	(12)	204		---		---
(4)	4K FORKLIFT (LOW MAST)	15K	(8)	120		---		---
(5)	STRADDLE TRAILER/TRACTOR	40K	(6)	240		---		---
(6)	CARGO TRUCK W/CRANE (DUNNAGE/BATTERY)	50K	(3)	150	(3)	150	(1)	50
(7)	20K PLATFORM TRUCK (PAL-W)	20K		---	(4)	80		---
(8)	22½ TON, M871 TRANSPORTER	16K		---	(4)	48		---
(9)	M878 YARD TRACTOR	50K		---	(4)	200		---
(10)	ATS-INTRA-DEPOT SHUTTLE TRUCK	80K		---		---	(5)	400
(11)	ATS-DOCK MTD CONTAINER LOADING	---		---		---	(1)	300
(12)	ATS-CARGO TRUCK W/CONVEYOR	50K		---		---	(2)	100
(13)	PALS - PLATFORMS (88" x 108")	750.00		---	(5000)	3750		---
(14)	LOADING DOCK-AREA	---	(2)	780		---	(1)	190
(15)	IGLOO MODIFICATION	16K		---	(151)	2416		---
(16)	MAGAZINE APRON MODIFICATIONS				(100)	250		
	TOTAL EQUIPMENT COST:			2,058K		7,218		1,282K
	COST PER CONTAINER (2500)			$823.00		$2,887		$512.00

Figure 1

PALS

COMPARATIVE MANPOWER COST PER DEPOT
(Two (2) 10 Hour Shifts Per Day)

ACTIVITY	WOODEN SYSTEM	PLATFORM SYSTEM	ATS SYSTEM
(1) 50K RTCH	4	4	2
(2) 4K FLT (ELECT)	24	---	8
(3) 4K FLT (GED)	24	---	---
(4) 4K FLT (LOW MAST	16	---	---
(5) STRADDLE TRAILER/TRACTOR	12	---	---
(6) CARGO TRUCK W/CRANE	12	12	4
(7) 20K PLATFORM TRUCK	---	6	---
(8) M871 TRANSPORTER	---	8	---
(9) SHUTTLE TRUCK (ATS)	---	---	10
(10) ATS DOCK MTD LOADER	---	---	2
(11) ATS PRE-STAGING RAMP	---	---	4
(12) CARGO TRUCK W/CONVEYOR	---	---	4
(13) OUTLOADING CREW	45	18	12
(14) PREFABRICATION	84	(8)	(24)
M/h TO STUFF 100 CONTAINERS/DAY	221	56	70
LABOR COST PER CONTAINER $\frac{\text{(M/hx10x\$50.00/hr)}}{100}$	$1,105	$280	$350
LABOR COST TO OUTLOAD 2500 ISO CONTAINERS	$2,762K	$700K	$875K

Figure 2

PALS

COMPARATIVE MATERIAL COST PER DEPOT

ITEM	WOODEN SYSTEM	PLATFORM SYSTEM	ATS SYSTEM
(1) CORNER RESTRAINT BARS	(2) 390K	390K	(2) 390K
(2) LUMBER AND PLYWOOD	910K	125K	750K
(3) MECHANICAL RESTRAINT MEMBERS	---	1312K	---
MATERIAL COST:	1,300K	1,827K	1,140K
MATERIAL COST PER CONTAINER: (2500):	$520.00K	$730.00K	$456.00K

Figure 3

5/7/88

PALS

COST ANALYSIS

1. REQUIREMENT: Outload 2500 ISO Freight Containers in 25 Work Days Per Depot.

2. SYSTEMS:

a. WOODEN SYSTEM (EXISTING)

(1) Equipment Cost Per Depot

(a)	2 ea. 50K RT Container Handlers (162K x 2)	=	324K
(b)	8 ea. 4K Forklifts, Lowmast, GED (Container) (15K x 8)	=	120K
(c)	12 ea. 4K Forklifts Electric (Igloo) (20K x 12)	=	240K
(d)	12 ea. 4K Forklifts, GED, Pneumatic (Igloo) (17K x 12)	=	204K
(e)	6 ea. Straddle Trailer/Tractor (40K x 6)	=	240K
(f)	3 ea. Cargo Truck w/Crane (Dunnage & Battery) (50K x 3)	=	150K
(g)	2 ea. 100' x 300' Loading Dock (100' x 300' x $13.00/ft^2) x 2	=	780K

(2) Manpower Cost Per Depot

(a)	Operate 2 ea. 50K RT Container Handlers (4 Operators, 10/hrs. @ $50/Hr x 25)	=	50K
(b)	Operate 8 ea. 4K Lowmast, Forklifts (Container) (16 Operators, 10 hrs @ $50/Hr x 25)	=	200K
(c)	Operate 12 ea. 4K Electric Forklifts (Igloo) (24 Operators, 10 hrs @ $50/Hr x 25)	=	300K

Figure 4

(d) Operate 12 ea. 4K, GED, Pneumatic, Forklifts (Igloo) (24 Operators, 10 hrs @ $50/Hr x 25) = 300K

(e) Operate 6 ea. Straddle Trailers/Tractors (12 Operators, 10 hrs @ $50/Hr x 25) = 150K

(f) Operate w/Helper, 3 ea. Cargo Trucks w/ Crane (12 Operators, 10 hrs @ $50/Hr x 25) = 150K

(g) Outloading @ 4.5 M/Hr Per Container (4.5 M/Hr Per Container x $50/Hr x 2500 = 562K

(h) Prefabrication @ 8.4 M/Hr Per Container (8.4 M/Hr x $50/Hr x 2500) = 1050K

SUBTOTAL 2,762K

(3) Material Cost Per Depot

(a) Corner Restraint Bars - 2/Container ($78.00 x 5000) = 390K

(b) Lumber and Plywood @ $364/Container ($364.00 x 2500) = 910K

SUBTOTAL = 1,300K

b. PLATFORM SYSTEM:

(1) Equipment Cost Per Depot

(a) 2 ea. 50K RT Container Handlers (162K x 2) = 324K

(b) 4 ea. M871, 22½ Ton Transporters (16K x 4) = 48K

(c) 4 ea. M878 Yard Tractors (50K x 4) = 200K

(d) 4 ea. 20K Platform Trucks (Incl. Maint Float) (20K x 4) = 80K

(e) 3 ea. Flat Bed Cargo Trucks w/Crane (50K x 3) = 150K

(f) 6000 ea. PALS Platforms (B&P Design) ($750.00 x 5000) = 3,750K

Figure 5

(g)	15 ea. Modified Igloos (Dbl Doors & Apron) (16K x 151)	=	2,416K
(h)	100 ea Magazine Aprons Modified (625 ft^2 x \$4.00 x 100)	=	250K
	SUBTOTAL		7,218K

(2) Manpower Cost Per Depot:

(a)	Operate 2 ea. 50K RT Container Handlers (4 Operators, 10 hrs. @ \$50/Hr x 25)	=	50K
(b)	Operate 4 ea. 22½ Ton Container Transporters (8 Operators, 10 hrs @ \$50/Hr x 25)	=	100K
(c)	Operate 3 ea. 20K Platform Trucks (6 Operators, 10 hrs @ \$50/Hr x 25)	=	75K
(d)	Operate w/Helper, 3 ea. Cargo Trucks w/Crane (12 Operators, 10 hrs @ \$50/Hr x 25)	=	150K
(e)	Outloading Crew (3 Man) @ 3 Igloos (18 Men x 10 hrs @ \$50/Hr x 25)	=	225K
(f)	Prefabrication Crew (4 Men) (8 Men x 10 hrs @ \$50/Hr x 25)	=	100K
	SUBTOTAL	=	700K

(3) Materiel Cost Per Depot:

(a)	Corner Restraint Bars, 2/Container (\$78.00/Corner x 2 x 2500)	=	390K
(b)	Lumber (\$50.00/Container x 2500)	=	125K
(c)	Mech. Restraint Members (\$525.00/Container x 2500)	=	1312K
	SUBTOTAL		1,827K

Figure 6

c. ATS SYSTEM:

(1) Equipment Cost Per Depot

(a)	1 ea. 50K RT Container Handler	=	162K
(b)	4 ea. 4K Forklifts, Elect/Pneumatic (Igloo) (4 x 20K)	=	80K
(c)	5 ea. 20 Ton ATS Shuttle Trucks (Intra-Depot) (5 x 80K)	=	400K
(d)	1 ea. Dock Mounted Container Loader	=	300K
(e)	3 ea. Cargo Trucks (1 ea. w/Crane, 2 ea. w/ATS Conveyor) (3 x 50K)	=	150K
(f)	Dock, Facilities w/Overhead Protection (100' x 120' x $16.00/ft²)	=	190K
	SUBTOTAL		1,282K

(2) Manpower Cost Per Depot

(a)	Operate 1 ea. 50K RT Container Handler (2 Operators, 10 hrs @ $50/Hr x 25)	=	25K
(b)	Operate 3 ea. Cargo Trucks (1 ea. w/Crane, 2 ea. w/Conveyor) (6 Operators and 2 Helpers, 10 hrs @ $50/Hr x 25)	=	100K
(c)	Operate 4 ea. 4K Elect. Forklifts (8 Operators, 10 hrs @ $50/Hr x 25)	=	100K
(d)	Operate 5 ea. 20 Ton ATS Shuttle Trucks (10 Operators, 10 hrs @ $50/Hr x 25)	=	125K
(e)	Operate Dock Mtd. Container Loader (2 Operators, 10 hrs @ $50/Hr x 25)	=	25K
(f)	Operate Prestaging and Load Sizing Ramp (4 Operators, 10 hrs @ $50/Hr x 25)	=	50K

Figure 7

(g)	Two (2) Outloading Crews (3 Men ea.) (12 Men, 10 hrs @ $50/Hr x 25)	=	150K
(h)	Prefabrication Crew (12 Men) (24 Men, 10 hrs @ $50/Hr x 25	=	300K
		SUBTOTAL:	875K

(3) Materiel Cost Per Depot:

(a)	Corner Restraint Bars, 2/Container ($78.00/Corner x 2 x 2500)	=	390K
(b)	Lumber and Plywood ($300.00/Container x 2500)	=	750K
		SUBTOTAL	1,140

Figure 7 (Cont'd.)

PALS

SUMMARY OF COMPARATIVE COST PER DEPOT
(TO OUTLOAD 2,500 FREIGHT CONTAINERS)

ITEM	WOODEN SYSTEM	PLATFORM SYSTEM	ATS SYSTEM
EQUIPMENT	2,058K	7,218K	1,282K
MANPOWER	2,762K	700K	875K
MATERIAL	1,300K	1,827K	1,140K
TOTAL:	$6,120K	$9,745K	$3,297K
TOTAL COST PER CONTAINER:	$2,448K	$3,898.00	$1,318.00
% BASELINE COST DIFFERENCE =	0	+59%	-46%

Figure 8

APPENDIX F

BROOKS & PERKINS, INC.

ADVANCED STRUCTURES DIVISION

PRESTAGED AMMUNITION

PLATFORM

BROOKS & PERKINS RELATED EXPERIENCE DESIGNED & PRODUCED

— Lightweight Pallet for 155 MM Projective	(Picatinny Arsenal)
— Milvan Floor Roller and Locking System	(U.S. Army)
— Type "A" Mechanical Dunnage System	(U.S. Army)
— Type "B" Mechanical Dunnage System	(U.S. Army)
— HCU - 6/E Cargo Pallet (USAF 463L System)	(U.S. Air Force)
— HCU - 10/C Cargo Pallet (USAF 463L System)	(U.S. Air Force)
— Exterior & Interior Helicopter Platforms & Pallets	(U.S. Marine Corps)
— Gondola for External Helicopter Lift	(U.S. Army)
— Exterior Helicopter Platforms	(U.S. Army)
— Airdrops & Lapes Panels and Platforms	(U.S. Army)

b+p ADVANCED STRUCTURES DIV.

BROOKS & PERKINS
ADVANCED STRUCTURES DIVISION

CONCEPT FOR:

— Metal Prestaged Ammunition Platform

— Method of Securing Ammunition to the Platform

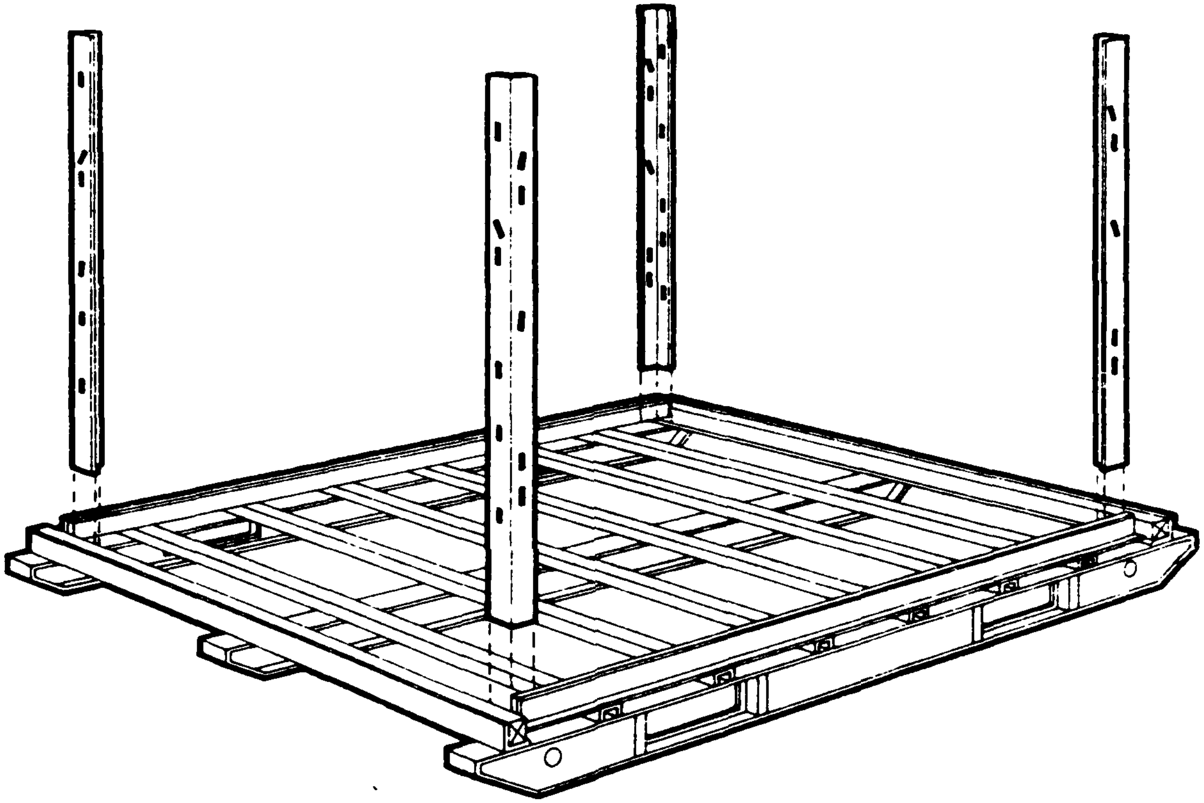
— Method of Securing Prestaged Platform in Container

— Handling Modes:

- * Four-way Forklift Entry
- * Helicopter and Crane Sling Load
- * Towable as a Sled Over Rough Terrain

— Empty Platforms Returned to Conus as Retrograde Cargo

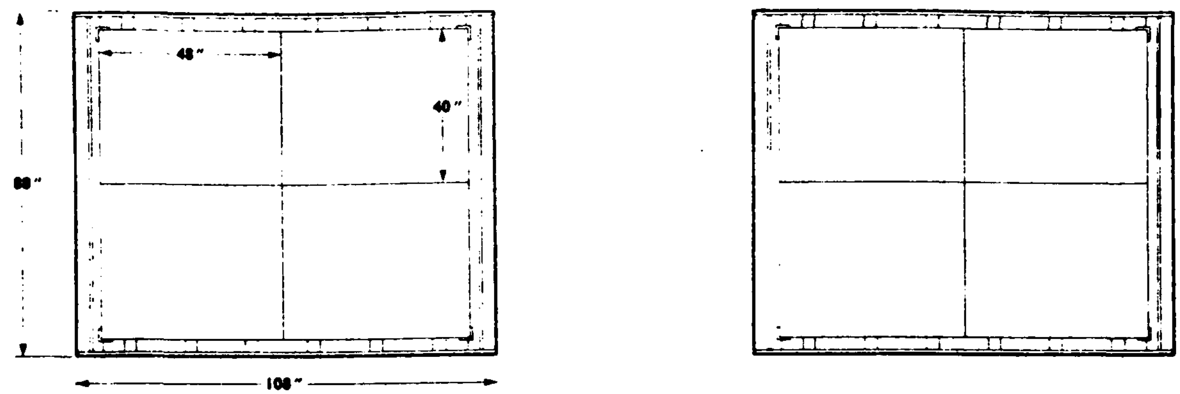
b+p ADVANCED STRUCTURES DIV.



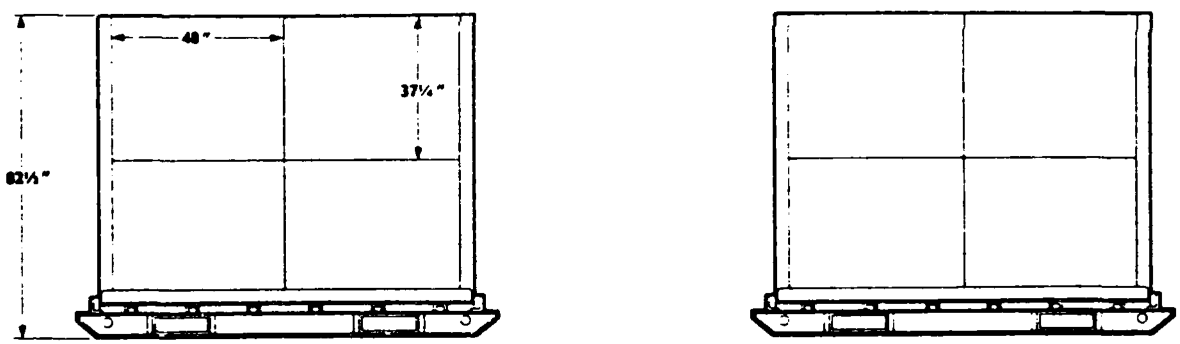
STANDARD PALLET AND CORNER ANGLES

1,002 LB. IN STEEL
389 LB. IN ALUMINUM ALLOY

b+p ADVANCED STRUCTURES DIV.



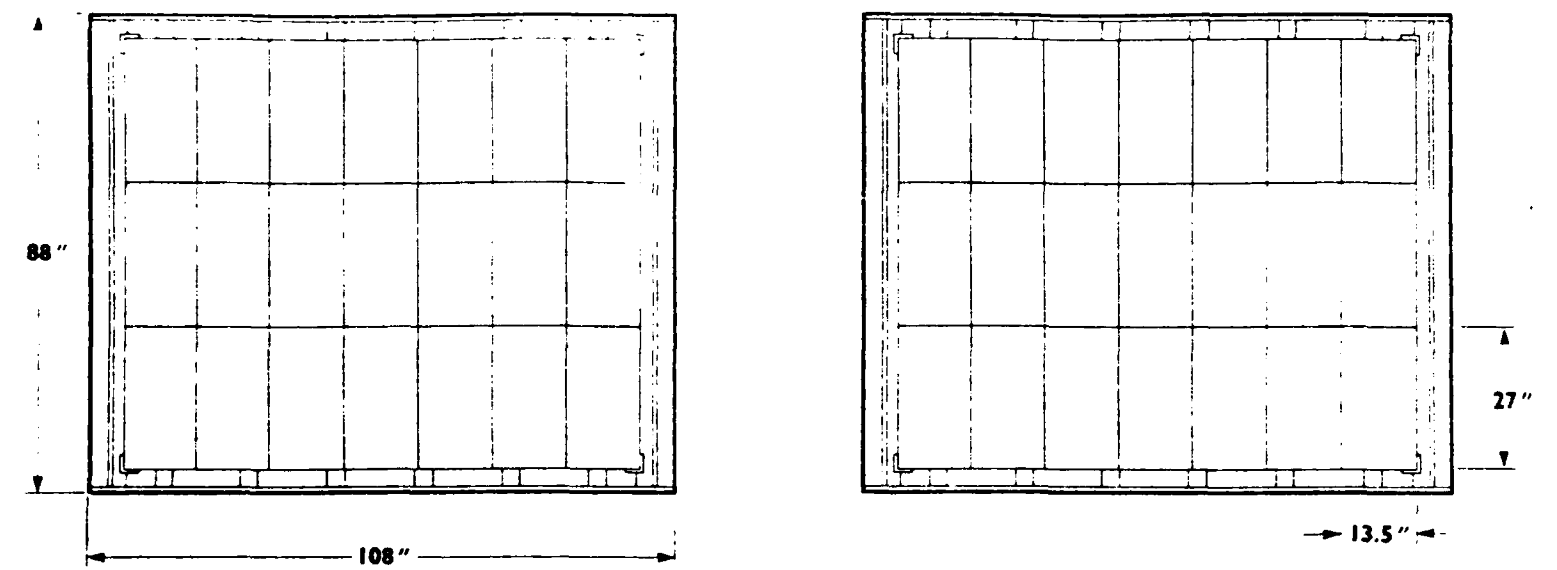
TOP VIEW



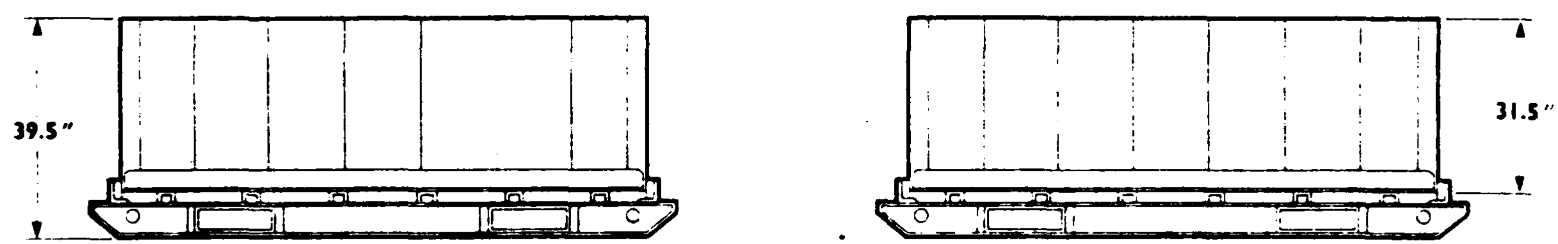
SIDE VIEW

105mm LOAD CONFIGURATION
16,920 LB. PER PALLET

b+p ADVANCED STRUCTURES DIV.



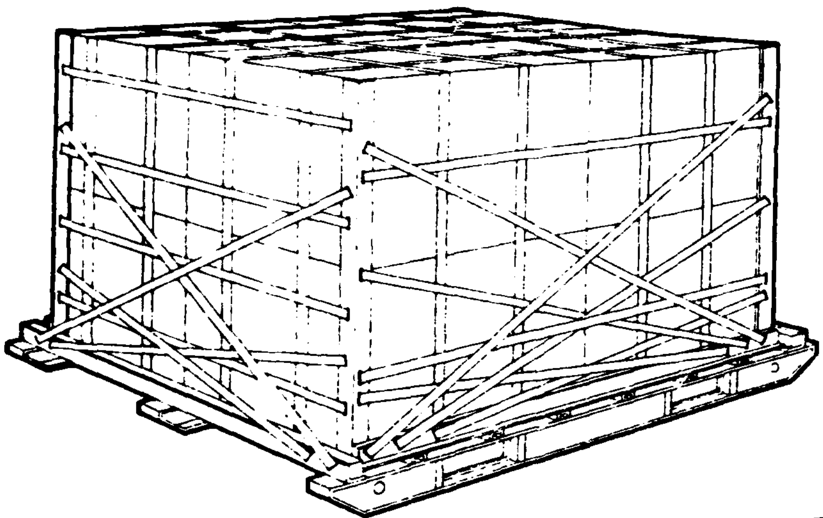
TOP VIEW



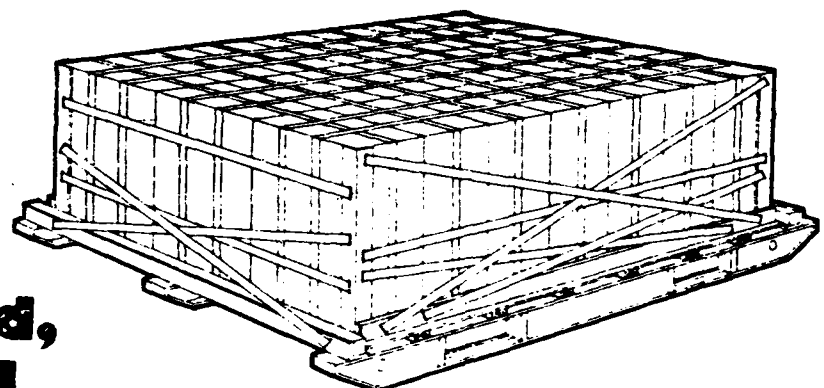
SIDE VIEW

155mm LOAD CONFIGURATION
18,200 LB. PER PALLET

b+p ADVANCED STRUCTURES DIV.

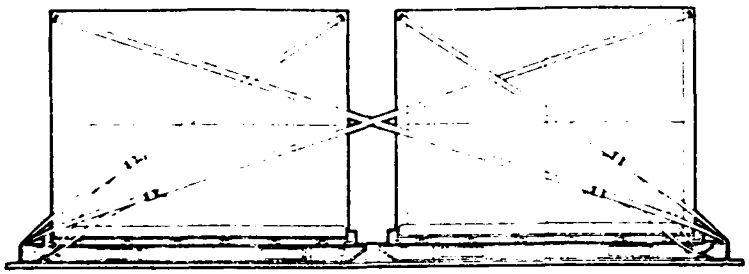


Pallet with 105mm loaded, strapped and unitized

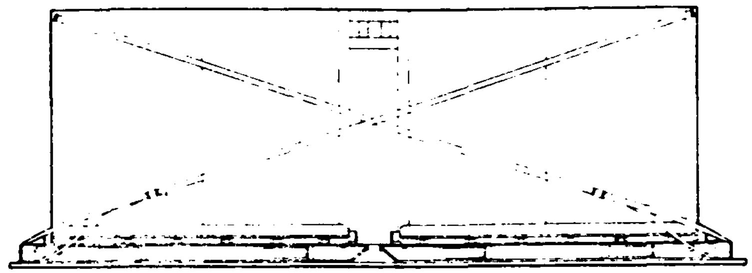


Pallet with 155mm loaded, strapped and unitized

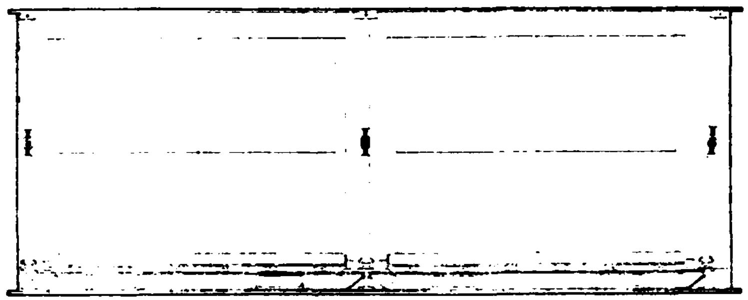
b+p ADVANCED STRUCTURES DIV.



DOUBLE STRAP



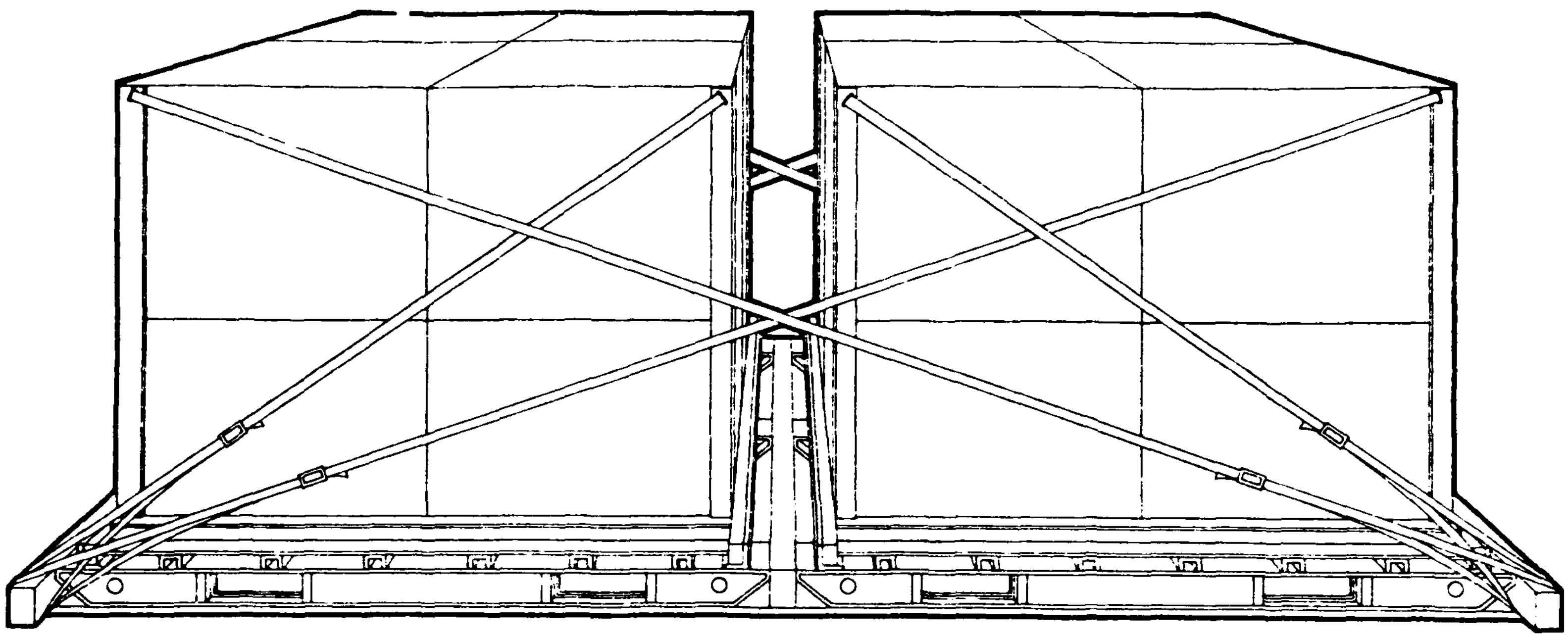
SINGLE STRAP



COMPRESSION I-BEAMS

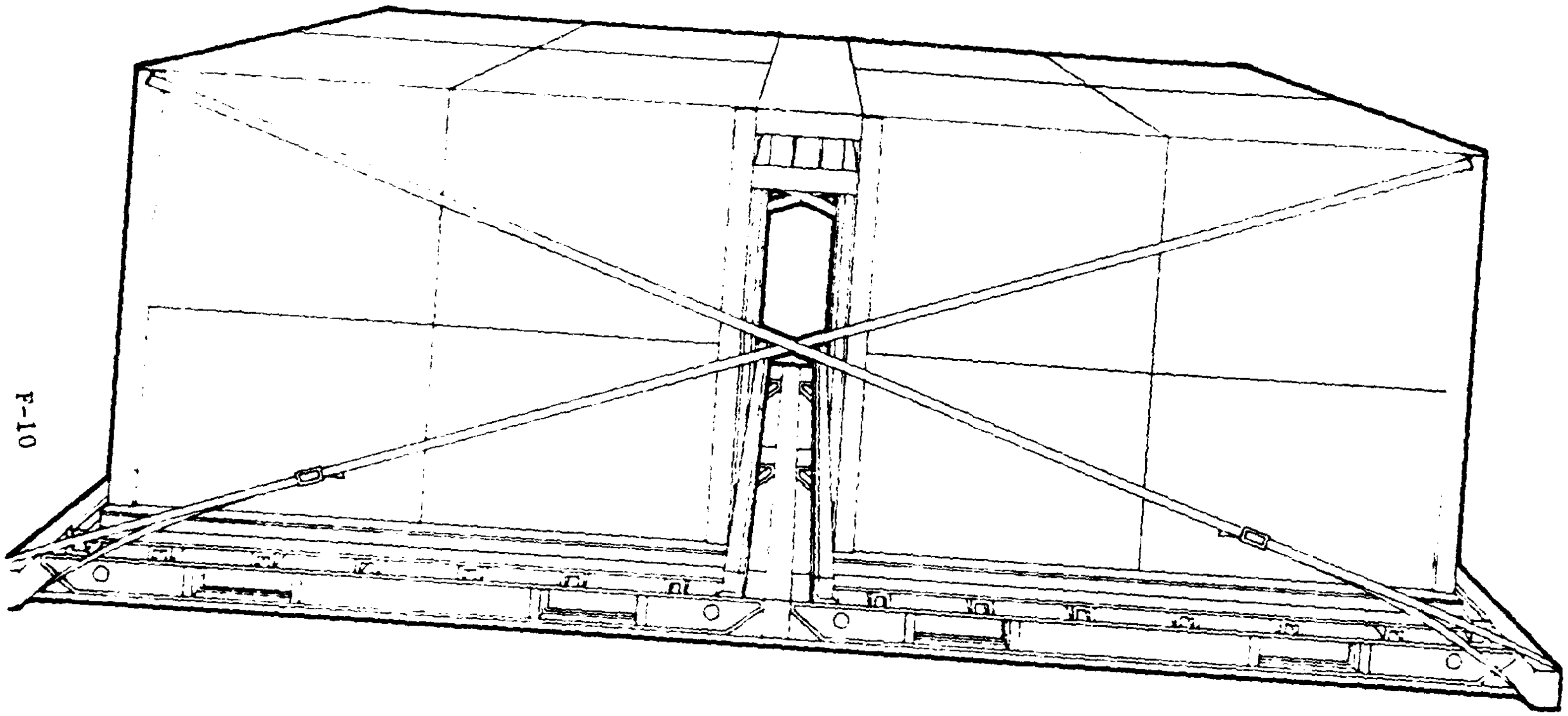
THREE CONCEPTS OF UNITIZED PALLETS RESTRAINED IN CONTAINER

b+p ADVANCED STRUCTURES DIV.



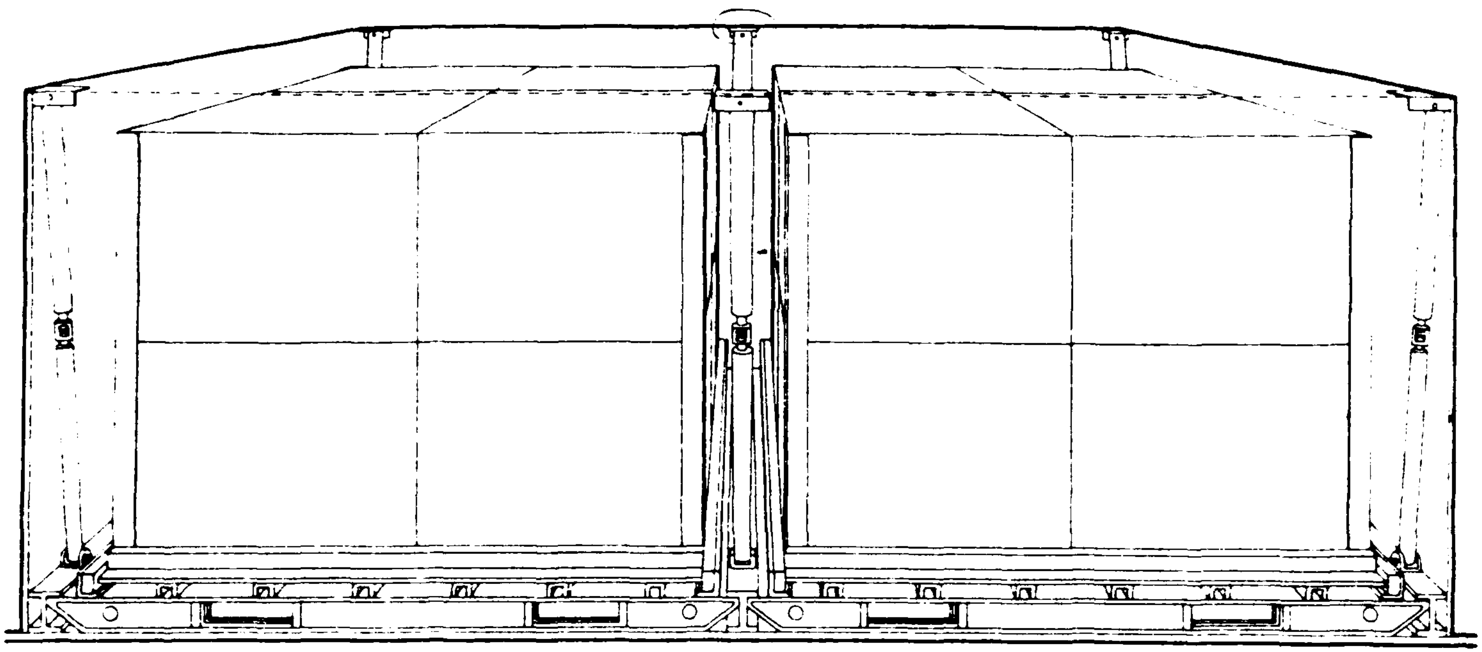
DOUBLE STRAP CONTAINER RESTRAINT

b+p ADVANCED STRUCTURES DIV.



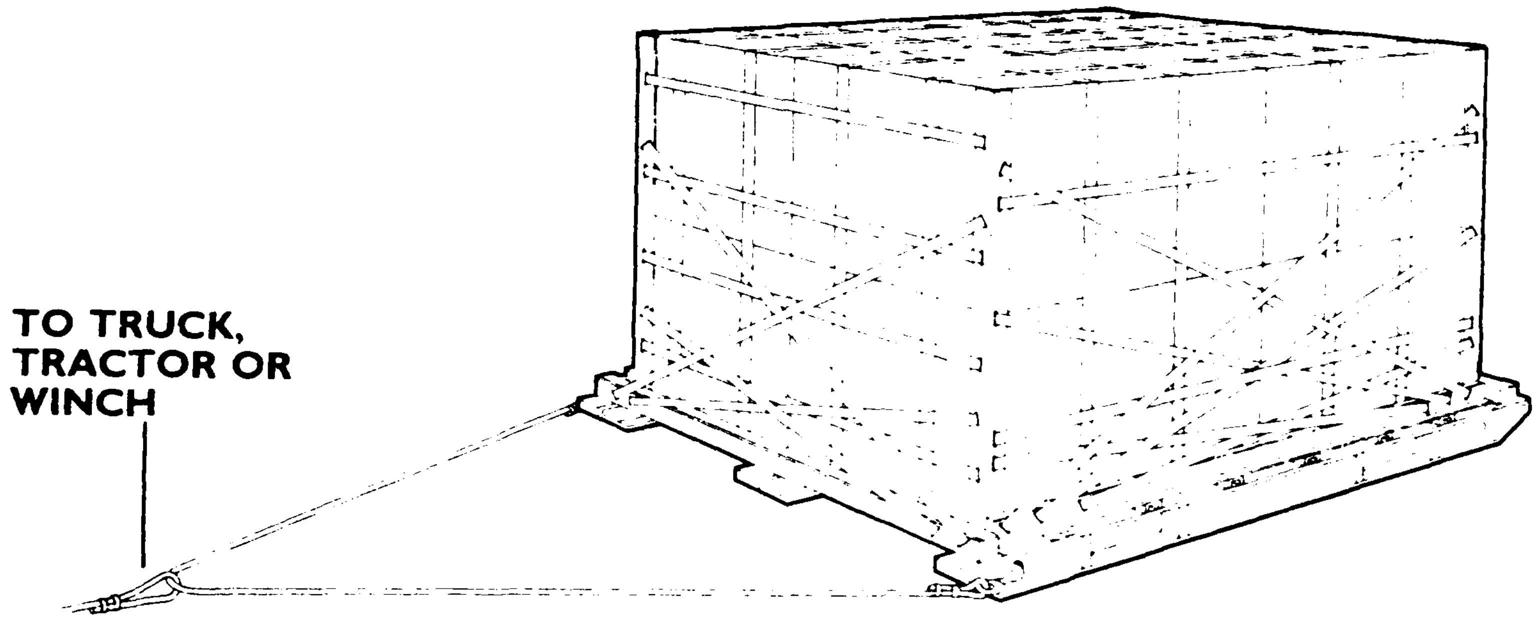
SINGLE STRAP CONTAINER RESTRAINT

b+p ADVANCED STRUCTURES DIV.



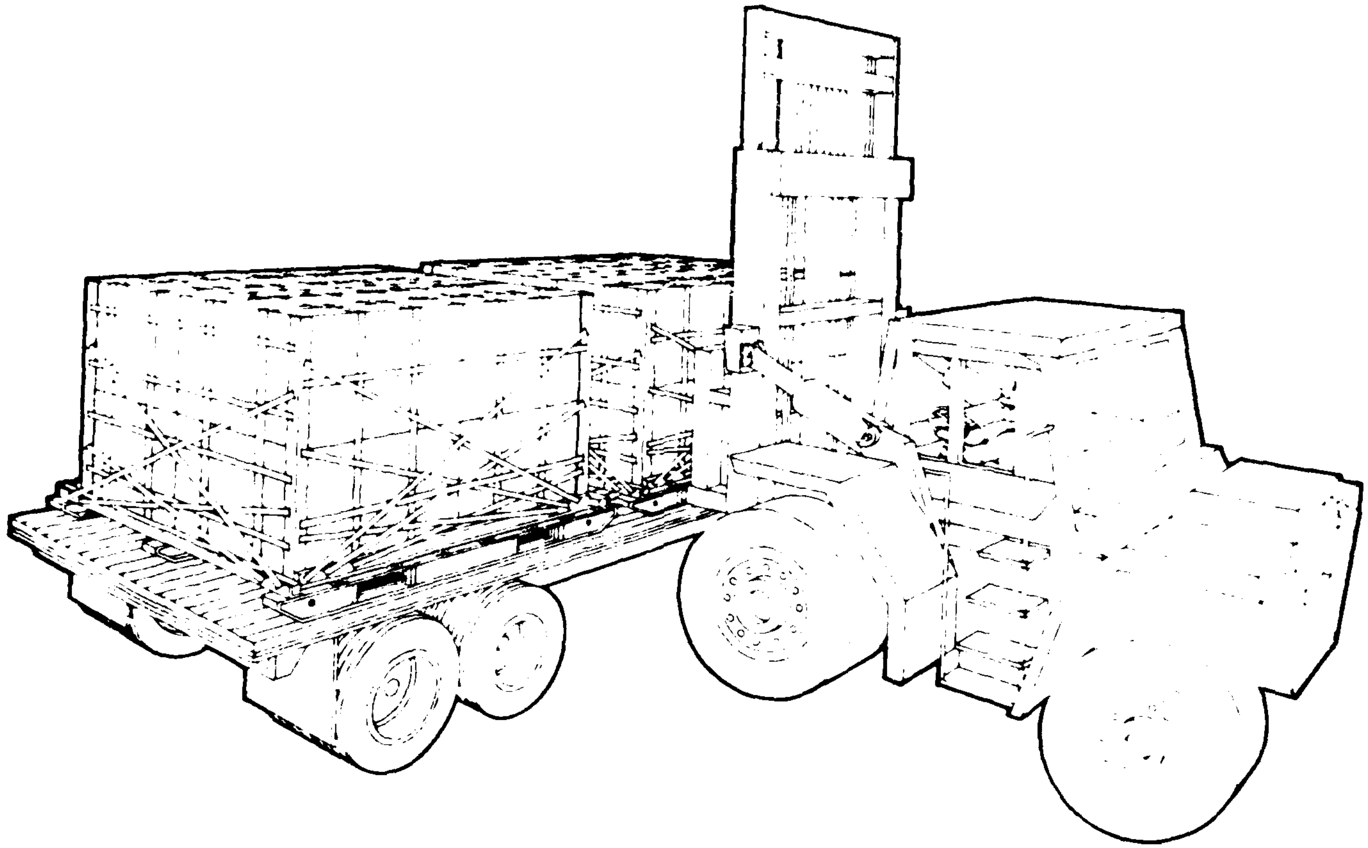
COMPRESSION I-BEAM CONTAINER RESTRAINT

b+p ADVANCED STRUCTURES DIV.



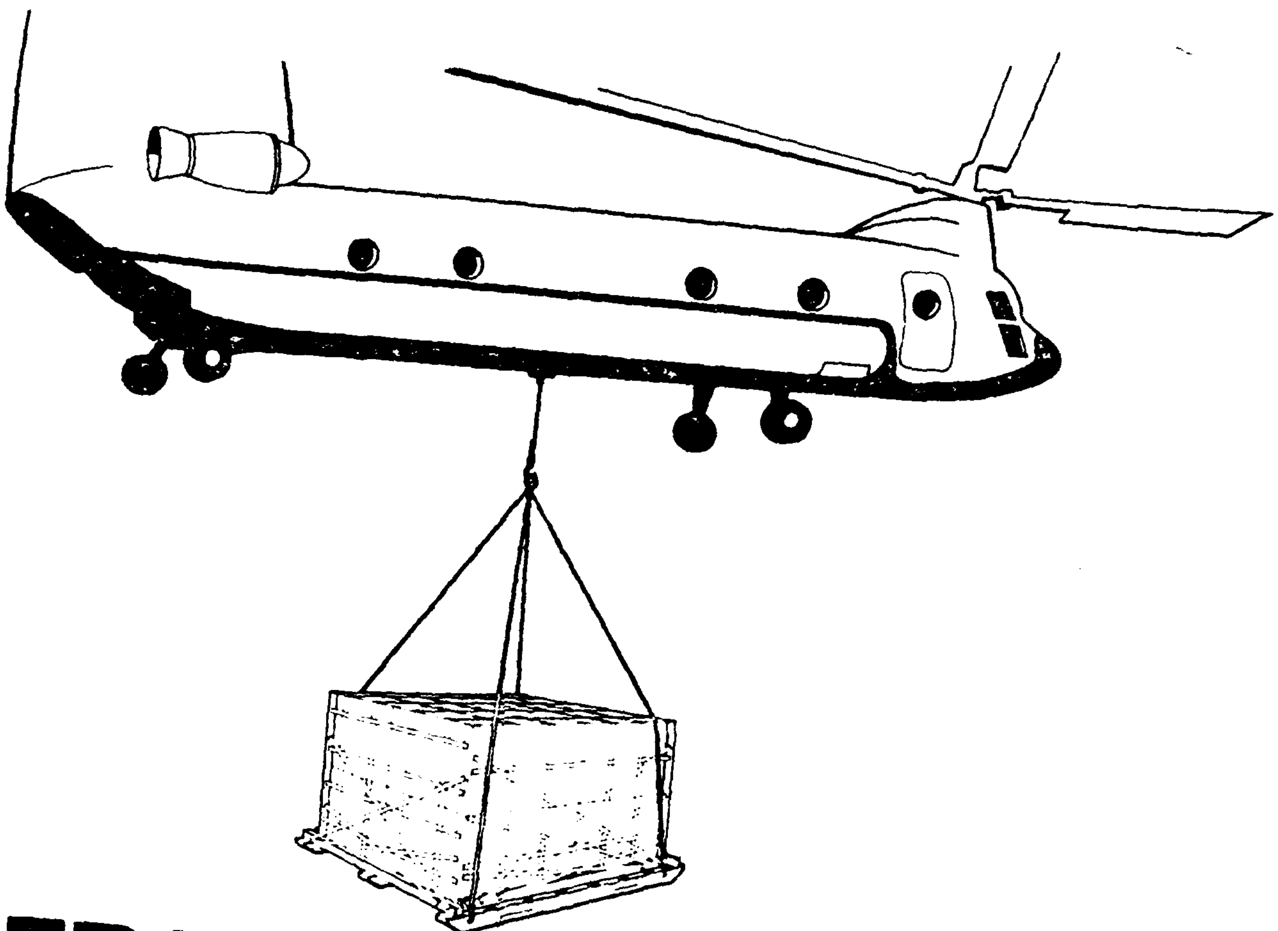
TRANSPORTABLE BY SKIDDING

b+p ADVANCED STRUCTURES DIV.



TRANSPORTABLE BY FORK LIFT TRUCK

b+p ADVANCED STRUCTURES DIV.



TRANSPORTABLE BY HELICOPTER OR CRANE

b+p ADVANCED STRUCTURES DIV.

APPENDIX G

MARTIN MARIETTA ALUMINUM SALES INC.
MILAN ARMY AMMUNITION PLANT
MILAN, TENNESSEE

October 10, 1979

COMMERCIAL CONTAINER TEST SHIPMENT
AFTER ACTION REPORT

I. Description of Operation:

Ten corrugated metal containers were received via commercial trailer during the latter part of August. These containers were unloaded using a 50,000-pound forklift with container attachment by a two man crew. The containers were moved to an overhead inspection fixture for crossmember inspection by Surveillance personnel, then stored at the marshalling area. A woodworking crew of six operators prefabricated the required dunnage at the Dunnage Mill prior to actual loadout. At time of loadout this crew was transferred to the stuffing location for installation of the dunnage.

M490, 105MM ammunition was removed from igloo storage by a two man crew using an electric forklift, inclined ramp, and portable loading dock. Ammunition was loaded into 30-foot plant trailers for transfer to the stuffing location approximately two miles away. No reconfiguration of pallets was required since the M490 is packaged in limited quantities for MILVAN shipment at the time of production. Unit size was 43 inches long by 45-1/2 inches wide by 39-1/2 inches high (24 rounds per pallet).

Containers were stuffed using a four man storage crew and two woodworkers. Two forklifts were used, one removed pallets of M490 from the plant trailer and positioned them near the container being stuffed, and the second forklift with side shift carriage loaded the pallets into the container. Two containers were stuffed at a time, one being stuffed while the separator assembly and rear side dunnage was being placed in position in the other. One lead operator directed these operations and prepared the necessary documentation. One operator performed miscellaneous jobs, such as, positioning ramps to trailers, labeling containers, and releasing trailers. Two woodworkers inserted and positioned the prefabricated dunnage assemblies prior to and during stuffing.

Four woodworkers working as a team inserted front blocking assemblies in all ten containers and when completed began installation of rear blocking assemblies on the stuffed containers.

Using the 50,000-pound forklift, the containers were loaded onto "bogies" for transfer to the Classification Yard for loading onto flatcars using a mobile rail crane. Normally flatcars are loaded at the stuffing location but due to reconstruction of two railroad trestles on this particular route transfer of containers for loading was required. This method requires 10 operators as compared to two operators normally used.

II. Time Study:

Activity time contains no allowances, delays, etc. Actual time contains all accountable hours including delays, travel time, break time, etc., which was charged to this operation.

A. Unload empty containers from commercial trailer (two containers per trailer) using 50,000-pound forklift with container attachment and position on concrete pad. (10 containers)

Actual Time	Crew Size	Total Actual MH
5.5 hrs.	2	11.0 MH

B. Transfer containers from position on pad to overhead inspection fixture using 50,000-pound forklift, wait for inspection of crossmembers by Surveillance personnel, and return containers to concrete pad for further inspection. (10 containers)

Actual Time	Crew Size	Total Actual MH
2.5 hrs.	2	5.0 MH

C. Prefabricate dunnage at Dunnage Mill using pneumatic nailers (10 containers - approximately 6,000 board feet) and transfer *assemblies to stuffing location.*

Actual Time	Crew Size	Total Actual MH
21.5 hrs.	6	129.0 MH

D. Transfer M490, 105MM (24 rounds per pallet) from igloo storage using electric forklift, inclined ramp, and portable loading dock to 30-foot plant trailer for transfer to stuffing location. (10 containers - 160 pallets)

Actual Time	Crew Size	Total Actual MH
8.0 hrs.	4	32.0 MH

E. Move front blocking assembly from roadside storage to container, fabricate load bearing pieces to assembly, position assembly, and return to roadside storage for next assembly.

Container No.	Activity Time	Crew Size
CLUU-210190-2	.3500 hrs.	4

Container No.	Activity Time	Crew Size	
CLUU-210074-2	.3167 hrs.	4	
CLUU-210104-0	.3167 hrs.	4	
CLUU-210096-9	.2833 hrs.	4	
CLUU-210106-0	.2667 hrs.	4	
CLUU-210075-8	.2667 hrs.	4	
CLUU-210101-3	.2667 hrs.	4	
CLUU-210184-1	.2500 hrs.	4	
CLUU-210165-1	.2667 hrs.	4	
CLUU-210092-7	.2500 hrs.	4	
Total Activity Time	2.8335 hrs.	4	11.3340 MH

Actual Time	Crew Size	Total Actual MH
5.25 hrs.	4	21.0 MH

F. Transfer pallets of M490 from plant trailer to concrete pad. Transfer pallets from pad to container. Install side dunnage and separator assemblies. Prepare necessary documentation after stuffing is completed.

Container No.	Activity Time	Crew Size	
CLUU-210190-2	.5667 hrs.	6	
CLUU-210074-2	.4500 hrs.	6	
CLUU-210104-0	.4667 hrs.	6	
CLUU-210096-9	.4333 hrs.	6	
CLUU-210106-0	.3333 hrs.	6	
CLUU-210075-8	.3667 hrs.	6	
CLUU-210101-3	.4167 hrs.	6	
CLUU-210184-1	.3833 hrs.	6	
CLUU-210165-1	.3833 hrs.	6	
CLUU-210092-7	.3500 hrs.	6	
Total Activity Time	4.1500 hrs.	6	24.9000 MH

Actual Time	Crew Size	Total Actual MH
8.0 hrs.	6	48.0 MH

G. Move rear blocking assembly from roadside storage to container, position assembly, fabricate struts, and install struts. Electric power saw was used to cut struts.

Container No.	Activity Time	Crew Size	
CLUU-210190-2	.4500 hrs.	4	
CLUU-210074-2	.4000 hrs.	4	
CLUU-210104-0	.3333 hrs.	4	
CLUU-210096-9	.3500 hrs.	4	
CLUU-210106-0	.3167 hrs.	4	
CLUU-210075-8	.3667 hrs.	4	
CLUU-210101-3	.2833 hrs.	4	
CLUU-210184-1	.3167 hrs.	4	
CLUU-210165-1	.2667 hrs.	4	
CLUU-210092-7	.2833 hrs.	4	
Total Activity Time	3.3667 hrs.	4	13.4668 MH

Actual Time	Crew Size	Total Actual MH
6.0 hrs.	4	24.0 MH

H. Load full containers onto "bogies" using 50,000-pound forklift, transfer containers to Classification Yard, load flatcars with mobile rail crane. (10 containers)

Actual Time	Crew Size	Total Actual MH
6.3 hrs.	10	63.0 MH

I. Miscellaneous activities:

1. Unload and store metal corner posts.

Actual Time	Crew Size	Total Actual MH
1.0 hrs.	2	2.0 MH

2. Remove tie down bars from rear corrugation in order to allow positioning of metal corner posts. Bars were cut out using acetylene torch.

Actual Time	Crew Size	Total Actual MH
2.5 hrs.	2	5.0 MH

III. Cost Study:

All labor and material costs are actual. Overhead and fringe benefit rates applied to these costs are based on average over the last 12 months. Transportation costs were taken from the GBL estimated transportation cost.

	Cost Activity	MH	Labor Cost	Material Cost	Transportation Cost	Total Cost
A.	Inbound transportation of empty container to Milan	-	$ -	$ -	$ 5,279.00	$ 5,279.00
B.	Unload empty containers	11.0	227.22	-	-	227.22
C.	Inspect containers	5.0	101.06	-	-	101.06
D.	Prefabricate dunnage	129.0	2,639.71	1,659.72	-	4,299.43
E.	Material handling from storage to stuffing location	32.0	661.99	-	-	661.99
F.	Installation of front blocking assembly	21.0	429.72	-	-	429.72
G.	Stuff container	48.0	974.22	-	-	974.22
H.	Installation of rear blocking assembly	24.0	491.12	-	-	491.12
I.	Load full containers onto flatcar	63.0	1,300.82	-	-	1,300.82
J.	Transportation to Sunny Point from Milan	-	-	-	10,335.00	10,335.00
K.	Miscellaneous costs:					
	1. Unload and store corner posts	2.0	40.42	-	-	40.42
	2. Remove tie down bars	5.0	79.72	-	-	79.72
	Grand Total	340.0	$6,946.00	$1,659.72	$15,614.00	$24,219.72

IV. Remarks:

A. This method was preferred over the IRSKIT Method used for the 1978 test shipment. Personnel at this plant are more familiar with the concepts employed in the use of wood dunnage than with the internal restraint system. Blocking and bracing resembled that used to brace railcars and required almost no learning by dunnage personnel.

B. Side fill dunnage was flimsy and hard to handle when moving. It also caused stuffing to be somewhat slower than is normally the case. One possible solution would be to make two side fill pieces from 2-inch by 4-inch stock instead of four from 1-inch by 4-inch stock and stagger them in the load. There would be no material savings but prefab labor would be less, assembly would be easier to handle, and stuffing would be facilitated.

C. No real problems were encountered except for tie down bars in containers which had to be removed prior to stuffing. These bars were cut from the containers with an oxy-acetylene torch prior to stuffing.

V. Photographs:

1. Tie down rods that required removal before corner post would fit container
2. Prefabricated dunnage stacked at roadside
3. Front blocking assembly and side fill piece in place
4. Plant trailer of M490 and inclined ramp used to unload trailer
5. Stuffing container
6. First pallet into position inside container
7. Container half loaded with separator assembly in place
8. Container fully loaded with rear blocking assembly in position
9. Container being loaded onto flatcar at Classification Yard using mobile rail crane
10. Containers CLUU-210106-0, CLUU-210075-8, CLUU-210101-3, and CLUU-210184-1 on TTAX-979869
11. Containers CLUU-210190-2, CLUU-210074-2, CLUU-210104-0, and CLUU-210096-9 on TTAX-973611
12. Containers CLUU-210165-1 and CLUU-210092-7 on TTAX-974241

APPENDIX H

APPROVED BY U S COAST GUARD	APPROVED BY BUREAU OF EXPLOSIVES
DATE 3/30/77	SUPERVISOR, MILITARY & INTERMODAL SERVICES DATE 3/22/77

INTERIM PROCEDURES

LOADING AND BRACING WITH WOODEN DUNNAGE IN COMMERCIAL CONTAINERS (METHOD 2) OF PALLETIZED UNITS OF 155MM SEPARATE LOADING PROJECTILES

THE INTERIM LOADING AND BRACING PROCEDURES SPECIFIED BY THIS DRAWING ARE ONLY APPLICABLE FOR USE ONE TIME, UNLESS OTHERWISE DIRECTED, IN SUPPORT OF A TRIAL SHIPMENT PROGRAM. APPROVAL OF THIS DRAWING, AS REFLECTED HEREON, IS BASED ON THE CONSTRAINTS SET FORTH IMMEDIATELY ABOVE.

THE DEPICTED WOODEN DUNNAGE METHOD CAN BE APPLIED TO ANY COMMERCIAL INTERMODAL 20-FOOT CONTAINER, ALTHOUGH THE DUNNAGE DIMENSIONS HAVE BEEN GIVEN FOR A 92" WIDE BY 95" *HIGH (INSIDE DIMENSIONS) CONTAINER.

LOADING AND BRACING SPECIFICATIONS AS DELINEATED HEREIN ARE ADEQUATE FOR SHIPMENTS TO BE MOVED BY ANY SURFACE MODE OF TRANSPORT (MOTOR, RAIL, AND WATER).

REQUIREMENTS CITED WITHIN THE BUREAU OF EXPLOSIVES PAMPHLET 6C APPLY WHEN THE SHIPMENT MOVES BY TRAILER/CONTAINER-ON-FLAT-CAR (T/COFC). SPECIAL T/COFC NOTES FOLLOW:

A. A LOADED CONTAINER MUST BE ON A CHASSIS EQUIPPED WITH TWO BOGIE ASSEMBLIES WHEN BEING MOVED IN TOFC SERVICE.

B. THE LOAD LIMIT OF A T/COFC RAIL CAR MUST NOT BE EXCEEDED, NOR WILL A CAR BE LOADED SO THAT THE TRUCK UNDER ONE END OF THE CAR CARRIES MORE THAN ONE-HALF OF THE LOAD LIMIT FOR THAT CAR.

DURING INTRASTATE AND/OR INTERSTATE MOVES BY MOTOR CARRIER, A PROPER CHASSIS/MODIFIED FLAT BED TRAILER MUST BE USED TO PRECLUDE VIOLATION OF ONE OR MORE "WEIGHT LAWS" APPLICABLE TO THE STATE OR STATES INVOLVED.

* NOTICE: ALTHOUGH THE LOAD AS SHOWN IS BASED ON A 8'-6" HIGH CONTAINER, AN 8'-0" HIGH CONTAINER IS PREFERRED FOR SHIPPING THE DEPICTED LOAD. WHEN AN 8'-0" HIGH CONTAINER IS USED, THE HEIGHT OF SOME DUNNAGE ASSEMBLIES WILL HAVE TO BE LOWERED BY REMOVING SOME MATERIAL FROM THE TOP OF THE VERTICAL PIECES.

REVISIONS

DRAFTSMAN / PROJ ENG / CHECKER

APPROVED, U S ARMY ARMAMENT MATERIEL READINESS COMMAND

APPROVED BY ORDER OF COMMANDING GENERAL, U S ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND (DARCOM)

DARCOM AMMO CENTER

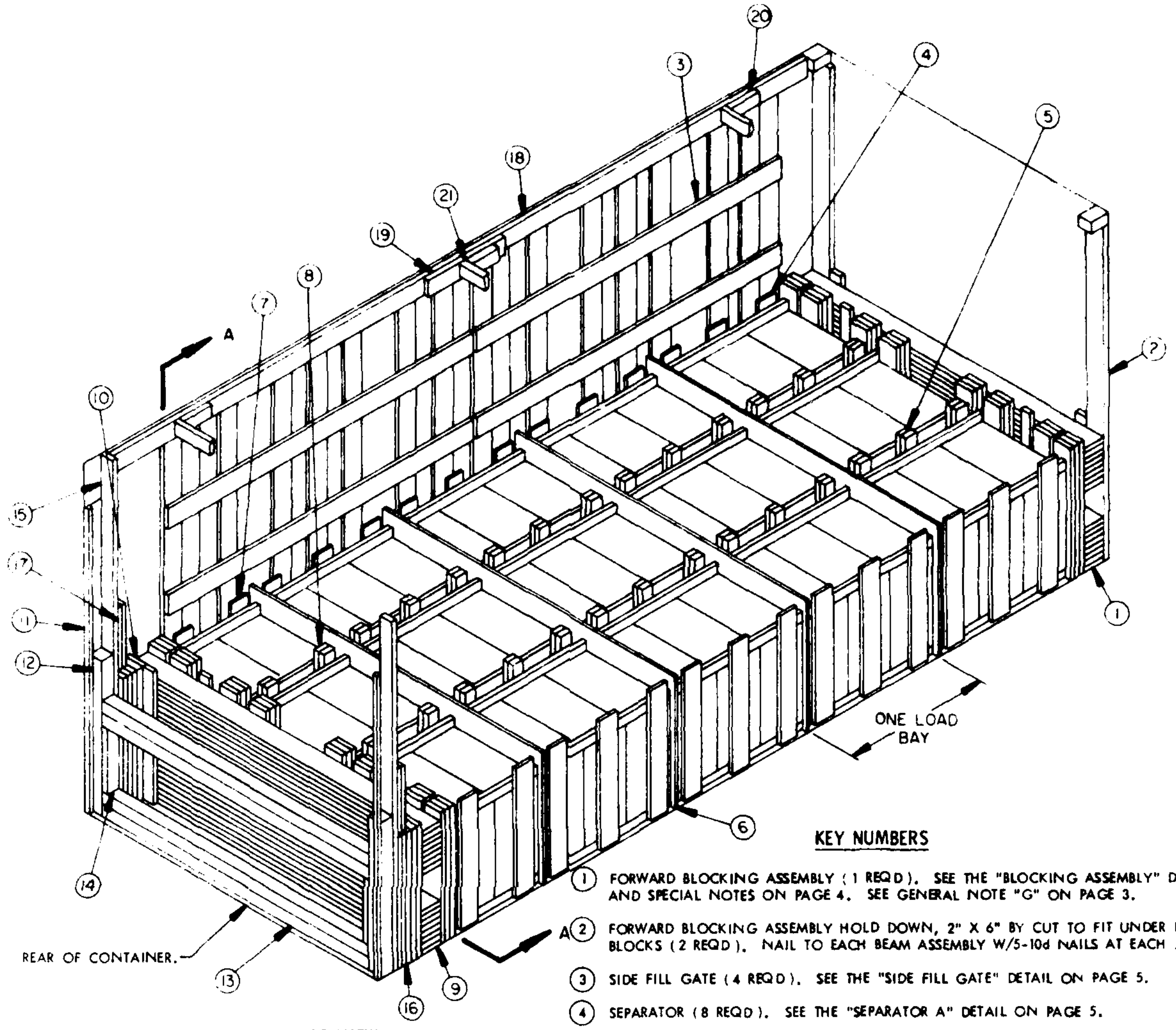
U. S. ARMY DARCOM DRAWING

DATE: MARCH 1977

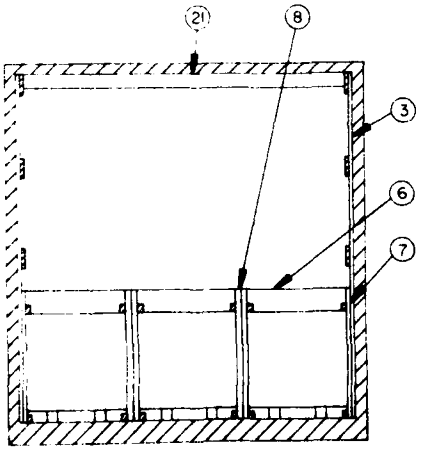
DARCOM AMMO CEN DWG NO.

D-SARAC-4395

DO NOT SCALE



ISOMETRIC VIEW



SECTION A-A

KEY NUMBERS

1. FORWARD BLOCKING ASSEMBLY (1 REQD). SEE THE "BLOCKING ASSEMBLY" DETAIL AND SPECIAL NOTES ON PAGE 4. SEE GENERAL NOTE "G" ON PAGE 3.
2. FORWARD BLOCKING ASSEMBLY HOLD DOWN, 2" X 6" BY CUT TO FIT UNDER LIFTING BLOCKS (2 REQD). NAIL TO EACH BEAM ASSEMBLY W/5-10d NAILS AT EACH JOINT.
3. SIDE FILL GATE (4 REQD). SEE THE "SIDE FILL GATE" DETAIL ON PAGE 5.
4. SEPARATOR (8 REQD). SEE THE "SEPARATOR A" DETAIL ON PAGE 5.
5. SEPARATOR (16 REQD). SEE THE "SEPARATOR B" DETAIL ON PAGE 6.
6. LOAD BEARING GATE (4 REQD). SEE THE "LOAD BEARING GATE" DETAIL ON PAGE 7.
7. SEPARATOR (2 REQD). SEE THE "SEPARATOR C" DETAIL ON PAGE 5.
8. SEPARATOR (4 REQD). SEE THE "SEPARATOR D" DETAIL ON PAGE 6.
9. REAR BLOCKING ASSEMBLY (1 REQD). SEE THE "BLOCKING ASSEMBLY" DETAIL ON PAGE 4.
10. BEARING PIECE, 2" X 6" X 36" (2 REQD). NAIL TO EACH BEAM ASSEMBLY W/5-10d NAILS AT EACH JOINT.
11. DOOR POST VERTICAL RETAINER (2 REQD). SEE THE "DOOR POST VERTICAL RETAINER" DETAIL ON PAGE 8.
12. HARDWOOD DOOR POST VERTICAL, 4" X 4" X 42" (2 REQD). SEE "DETAILS A" AND "B" ON PAGE 7.
13. DOOR SPANNER, 4" X 4" MATERIAL, CUT TO A LENGTH THAT WILL PROVIDE FOR A DRIVE FIT (REF: 7'-1") (4 REQD). TOENAIL TO THE 4" X 4" DOOR POST VERTICALS W/2-12d NAILS AT EACH END. SEE THE "BEVEL-CUT" DETAIL ON PAGE 7.
14. DOOR SPANNER SUPPORT PIECE, 2" X 4" X 17-1/2" (2 REQD). NAIL TO A DOOR POST VERTICAL W/4-10d NAILS AFTER THE LOWER DOOR SPANNER PIECES ARE IN POSITION.
15. HOLD-DOWN PIECE, 2" X 4" BY CONTAINER HEIGHT MINUS 1/2" (2 REQD). NAIL TO THE DOOR POST VERTICAL W/4-10d NAILS.
16. FILL MATERIAL, 6" WIDE BY 36" LONG MATERIAL (AS REQD). NAIL EACH PIECE TO THE REAR BLOCKING ASSEMBLY AND/OR LAMINATE TOGETHER W/4-NAILS OF A SUITABLE SIZE (10d NAILS FOR 2" THICK MATERIAL). CAUTION: DO NOT NAIL TO THE 2" X 4" HOLD DOWN PIECE.

(CONTINUED ON PAGE 3)

(KEY NUMBERS CONTINUED FROM PAGE 2)

(17) REAR BLOCKING ASSEMBLY HOLD DOWN PIECE, 2" X 4" X 18" (DOUBLED) (2 REQD). POSITION ONE-HALF INCH (1/2") ABOVE FILL MATERIAL AND NAIL THE FIRST PIECE TO THE 2" X 4" HOLD DOWN W/4-10d NAILS, NAIL THE SECOND PIECE TO THE FIRST IN A LIKE MANNER.

(18) TIE PIECE, 1" X 6" MATERIAL (REF: TWO 9'-0" LONG PIECES AND TWO 9'-4" LONG PIECES REQD). POSITION A TIE PIECE NEAR THE TOP OF PIECES MARKED (3), SLIGHTLY BELOW THE ROOF BOWS OF THE CONTAINER. CONTACT BETWEEN THE TIE PIECES AND THE BOWS IS NOT PERMITTED. NAIL TO EACH VERTICAL PIECE OF THE SIDE FILL GATE W/4-4d NAILS. SEE GENERAL NOTE "K" AT THE RIGHT.

(19) SPLICE PIECE, 1" X 6" X 24" (2 REQD). NAIL TO TWO LONGITUDINALLY ADJACENT TIE PIECES W/5-6d NAILS AT EACH END.

(20) SPANNER PIECE CLEAT, 2" X 4" X 9" (6 REQD). NAIL TO THE TIE PIECE OR SPLICE PIECE W/3-10d NAILS. LOCATE IN SUCH A MANNER THAT A SPANNER PIECE WILL BE IN LINE WITH THE VERTICAL PIECES ON THE SIDE FILL GATE.

(21) SPANNER PIECE, 2" X 4" MATERIAL, CUT TO A LENGTH THAT WILL PROVIDE FOR A TIGHT FIT (REF: 7'-5" AND 7'-6-1/2") (3 REQD). POSITION AGAINST A SET OF SPANNER PIECE CLEATS AND TOENAIL TO THE TIE PIECES W/2-12d NAILS AT EACH END.

* IF DESIRED, PIECES MARKED (18) THRU (21) MAY BE INSTALLED PRIOR TO LOADING A CONTAINER.

BILL OF MATERIAL

LUMBER	LINEAR FEET	BOARD FEET
1" X 6"	472	236
2" X 2"	6	2
2" X 3"	187	94
2" X 4"	243	162
2" X 6"	429	429
4" X 4"	35	47
NAILS	**NO. REQD**	**POUNDS**
4d (1-1/2")	144	3/4
6d (2")	260	1-3/4
10d (3")	790	12-1/4
12d (3-1/4")	86	1-1/2
16d (3-1/2")	224	5

PLYWOOD, 1/2 ------------------ 91 SQ FT REQD --- 126 LBS
DOOR POST VERTICAL RETAINER --- 2 REQD --------- 64 LBS

MATERIAL SPECIFICATIONS

LUMBER ------------ : SEE TM 743-200-1, DUNNAGE LUMBER; FED SPEC MM-L-751.

NAILS ------------ : COMMON, CEMENT COATED, OR CHEMICALLY ETCHED: FED SPEC FF-N-105.
ALT: ANNULAR-RING TYPE NAIL OF THE SAME SIZE.

STEEL, STRUCTURAL-- : SQUARE STRUCTURAL TUBING, AND ROLLED PLATE; FED SPEC QQ-S-741.

PLYWOOD --------- : GROUP B OR C, GRADE C-D (EXTERIOR), FED SPEC NN-P-530. A BETTER EXTERIOR GRADE MAY BE SUBSTITUTED.

GENERAL NOTES

A. THIS DOCUMENT HAS BEEN PREPARED AND ISSUED IN ACCORDANCE WITH AR 740-1, AND AUGMENTS TM 743-200-1 (CHAPTER 5).

B. THIS DOCUMENT HAS BEEN PREPARED AND ISSUED TO SUPPORT A TRIAL SHIPMENT PROGRAM. THE DELINEATED OUTLOADING PROCEDURES SPECIFY A "WOODEN DUNNAGE" METHOD OF BLOCKING AMMUNITION IN COMMERCIAL INTERMODAL CONTAINERS.

C. THE SPECIFIED OUTLOADING PROCEDURES ARE ONLY APPLICABLE TO A LOAD OF 155MM SEPARATE LOADING PROJECTILES WHEN PACKED EIGHT PROJECTILES PER PALLET. SUBSEQUENT REFERENCE TO PALLET MEANS THE PALLET WITH AMMUNITION ITEMS.

D. THE LOAD AS SHOWN IS BASED ON A 4,700 POUND 20' LONG BY 8' WIDE X 8'-6" HIGH INTERMODAL COMMERCIAL CONTAINER WITH INSIDE DIMENSIONS OF 19'-4" LONG BY 92" WIDE BY 95" HIGH. THE LOAD IS DESIGNED FOR TRAILER/CONTAINER-ON-FLATCAR (T/COFC) SHIPMENT, HOWEVER, THE LOAD AS DESIGNED CAN ALSO BE MOVED BY OTHER SURFACE MODES OF TRANSPORT. SEE SPECIAL NOTE 2 ON PAGE 4. NOTICE: OTHER CONTAINERS OF THE SAME CONFIGURATION DESIGN CAN BE USED; HOWEVER, A 20-FOOT CONTAINER THAT IS HEAVIER THAN 9,049 POUNDS CANNOT BE USED BECAUSE THE RESULTANT GROSS WEIGHT WOULD EXCEED THE PERMITTED MAXIMUM OF 44,800 POUNDS.

E. WHEN LOADING PALLET UNITS, THEY ARE TO BE POSITIONED SO AS TO ACHIEVE A TIGHT LOAD (TIGHT AGAINST FORWARD AND SIDE DUNNAGE ASSEMBLIES). ALTHOUGH A TOTAL OF ONE AND ONE-HALF INCHES (1-1/2") OF UNBLOCKED SPACE ACROSS THE WIDTH OF A LOAD BAY IS PERMITTED, LATERAL VOIDS WITHIN THE LOAD ARE TO BE HELD TO THE MINIMUM. EXCESSIVE SLACK CAN BE ELIMINATED FROM A LOAD BY LAMINATING ADDITIONAL PIECES OF APPROPRIATE THICKNESS TO THE VERTICAL PIECES OF SEPARATORS B AND D. EACH ADDITIONAL PIECE WILL BE NAILED IN PLACE W/3-APPROPRIATELY SIZED NAILS DRIVEN IN THE AREA ON THE SEPARATOR ASSEMBLY THAT IS ABOVE THE LOAD. WHEN ADDITIONAL FILL IS REQUIRED BETWEEN TWO PALLETS, THE ADJACENT PALLETS IN THAT LOAD BAY MUST HAVE THE SAME THICKNESS FILL MATERIAL INSTALLED THROUGHOUT IN THAT LOAD BAY.

F. DUNNAGE LUMBER SPECIFIED IS OF A NOMINAL SIZE. FOR EXAMPLE, 1" X 6" MATERIAL IS ACTUALLY 3/4" THICK BY 5-1/2" WIDE, 2" X 4" IS ACTUALLY 1-1/2" THICK BY 3-1/2" WIDE, AND 4" X 4" MATERIAL IS ACTUALLY 3-1/2" THICK BY 3-1/2" WIDE. NOTICE: ALL SPECIFIED DUNNAGE LUMBER IS SOFT-WOOD EXCEPT THAT REQUIRED FOR THE TWO DOOR POSTS MARKED AS PIECE (12). THE 42" LONG, 4" X 4" DOOR POSTS MUST BE HARDWOOD, SUCH AS OAK. IF DESIRED, PILOT HOLES FOR THE NAILS DRIVEN INTO THE DOOR POSTS MAY BE PREDRILLED.

G. A STAGGERED NAILING PATTERN WILL BE USED WHEREVER POSSIBLE WHEN NAILS ARE DRIVEN INTO JOINTS OF DUNNAGE ASSEMBLIES OR WHEN LAMINATING DUNNAGE.

H. IN SOME CONTAINERS, SUCH AS SOME ALL STEEL CONTAINERS, THERE IS A SLOT AT THE CORNER OF THE FORWARD WALL. A PIECE OF DUNNAGE MATERIAL MUST BE LAMINATED TO THE HOLD-DOWN PIECES ON THE FORWARD BLOCKING ASSEMBLY TO PROVIDE A FLAT SURFACE FOR THE 2" X 6" HOLD-DOWN PIECES. A PIECE OF 2" X 4", 2" X 3", OR A SPECIAL WIDTH PIECE CUT TO FIT CAN BE USED. THIS FILL PIECE WILL BE NAILED WITH ONE APPROPRIATELY SIZED NAIL EVERY 12". THIS PIECE IS NOT REQUIRED WHEN THE FRONT WALL OF THE CONTAINER IS SMOOTH AND FLAT.

J. CAUTION: DO NOT NAIL DUNNAGE MATERIAL TO THE CONTAINER WALLS OR FLOOR. ALL NAILING WILL BE WITHIN THE DUNNAGE.

K. PORTIONS OF THE CONTAINERS DEPICTED WITHIN THIS DRAWING, SUCH AS ONE OF THE SIDE WALLS, HAVE NOT BEEN SHOWN IN THE LOAD VIEWS FOR CLARITY PURPOSES.

L. RECOMMENDED SEQUENTIAL LOADING PROCEDURES:
1. PREFABRICATE SUB-ASSEMBLY FOR ONE FORWARD BLOCKING ASSEMBLY AND ONE REAR BLOCKING ASSEMBLY.
2. PREFABRICATE FOUR SIDE FILL GATES, EIGHT SEPARATORS "A", SIXTEEN SEPARATORS "B", TWO SEPARATORS "C", FOUR SEPARATORS "D", AND FOUR LOAD BEARING GATES. INSTALL THE HARDWOOD DOOR POST VERTICALS TO THE DOOR POST VERTICAL RETAINERS.
3. INSTALL THE FORWARD BLOCKING ASSEMBLY, TWO SIDE FILL GATES, AND TWO SEPARATOR A ASSEMBLIES.
4. LOAD NINE PALLETS AND INSTALL FOUR SEPARATOR B ASSEMBLIES.
5. INSTALL ONE LOAD BEARING GATE AND TWO SEPARATOR A ASSEMBLIES.
6. LOAD NINE PALLETS AND FOUR SEPARATOR B ASSEMBLIES.
7. INSTALL ONE LOAD BEARING GATE, TWO SIDE FILL GATES, AND TWO SEPARATOR A ASSEMBLIES.
8. LOAD NINE PALLETS AND FOUR SEPARATOR B ASSEMBLIES.
9. REPEAT STEP 5.
10. REPEAT STEP 6.
11. INSTALL ONE LOAD BEARING GATE.
12. INSTALL TWO SEPARATOR C ASSEMBLIES.
13. LOAD SIX PALLETS AND FOUR SEPARATOR D ASSEMBLIES.
14. INSTALL REAR BLOCKING ASSEMBLY.
15. INSTALL THE TWO DOOR POST VERTICALS WITH DOOR POST VERTICAL RETAINER AND 2" X 4" HOLD DOWN ATTACHED.
16. INSTALL TWO DOOR SPANNER PIECES AT THE LOWEST POSITION.
17. INSTALL THE SOLID FILL LOAD BLOCKING MATERIAL.
18. INSTALL THE DOOR SPANNER PIECE CLEAT AND THE REMAINING DOOR SPANNER PIECES.
19. INSTALL THE DOUBLED 2" X 4" HOLD DOWN.
20. INSTALL THE TIE PIECES, THE SPLICE PIECES, THE SPANNER PIECE CLEATS, AND THE THREE SPANNER PIECES. SEE " * " NOTE AT UPPER LEFT.

LOAD AS SHOWN

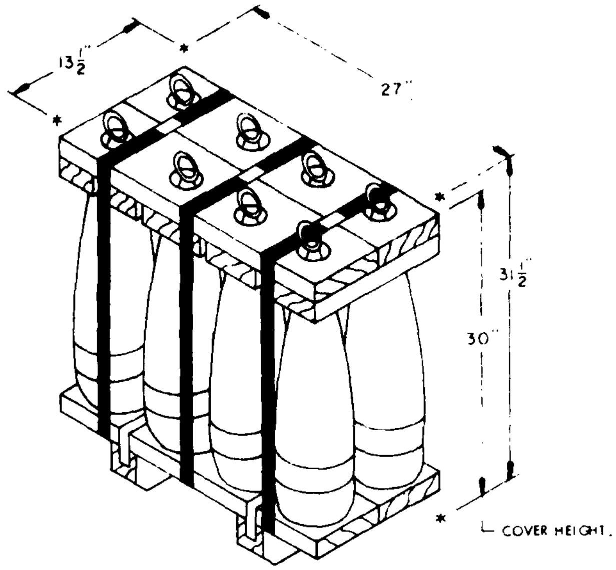
ITEM	QUANTITY	WEIGHT (APPROX)
PALLET UNIT	42	33,600 LBS
DUNNAGE		2,151 LBS
CONTAINER		4,700 LBS
TOTAL GROSS WEIGHT		40,451 LBS

SPECIAL NOTES:

1. THE BLOCKING ASSEMBLY DETAIL DEPICTED BELOW HAS BEEN SHOWN IN TWO SECTIONS TO FACILITATE LOADING OPERATIONS. PIECES MARKED ② FOR THE FORWARD BLOCKING ASSEMBLY, ARE NOT TO BE NAILED UNTIL THE SUB-ASSEMBLY MADE FROM THE OTHER PIECES IS MOVED INTO THE CONTAINER. LAY THE SUB-ASSEMBLY ON THE FLOOR OF THE CONTAINER WITH THE BEAMS RUNNING CROSSWISE AND THE BEAM ASSEMBLIES ON THE FLOOR. SLIDE THE SUB-ASSEMBLY FORWARD UNTIL THE BASE END OF THE BEAM ASSEMBLY CONTACTS THE FRONT WALL, AND THE BEAM ASSEMBLY IS AT EQUAL DISTANCES FROM THE SIDE WALLS OF THE CONTAINER. PLACE PIECE MARKED ② ON THE SUB-ASSEMBLY WITH THE OUTER EDGE OF EACH PIECE ALMOST IN CONTACT WITH THE ADJACENT SIDE WALL OF THE CONTAINER. NAIL EACH PIECE AS SPECIFIED. RAISE THE ASSEMBLY AND POSITION AGAINST THE FORWARD WALL OF THE CONTAINER. MOVE THE SECOND HALF OF THE SUB-ASSEMBLY INTO PLACE UNTIL THE SUPPORT PIECES ON BOTH SIDES ARE IN CONTACT WITH ALL 2" X 6" BEAM ASSEMBLIES. NAIL THE REAR RETAINER PIECES TO THE FORWARD BEAM ASSEMBLIES AS SPECIFIED. PLACE THE LAST TWO LOAD BEARING PIECES WITH THE OUTER EDGE OF EACH PIECE ALMOST IN CONTACT WITH THE ADJACENT SIDE WALLS OF THE CONTAINER. NAIL EACH PIECE AS SPECIFIED.

   WHEN FABRICATING THE REAR BLOCKING ASSEMBLY, THE FINAL ASSEMBLY IS TO BE ACCOMPLISHED IN ACCORDANCE WITH THE PRINCIPLES DELINEATED ABOVE. PIECE MARKED ⑩ WILL BE USED IN LIEU OF PIECE MARKED ②.

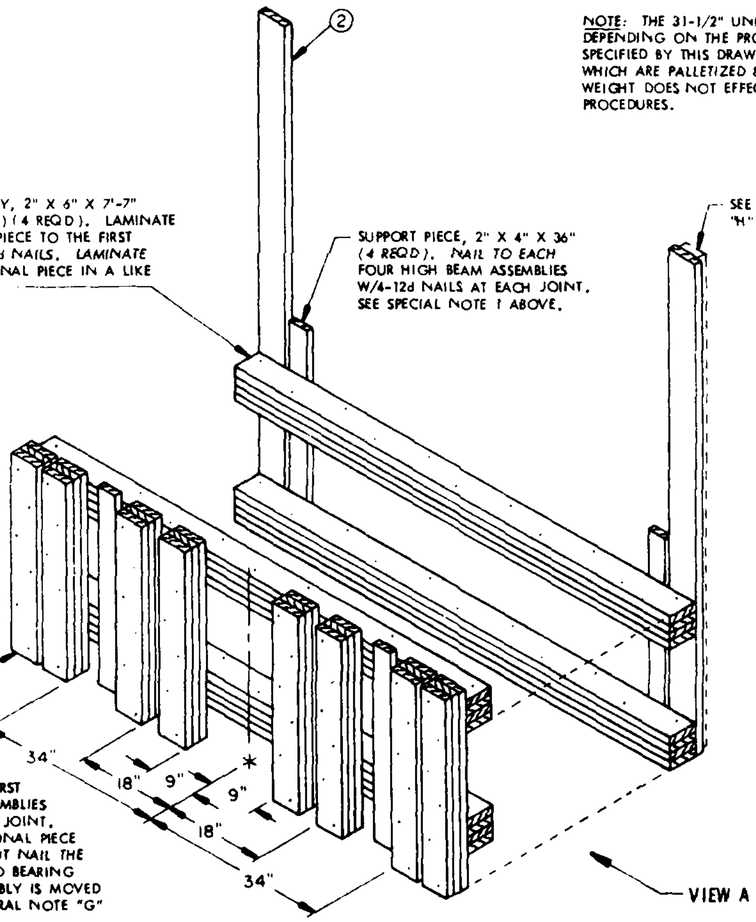
2. THE SIDE FILL GATE DETAILED ON PAGE 5 HAS BEEN DIMENSIONED FOR A CONTAINER WITH AN INSIDE HEIGHT OF 95". WHEN THE INSIDE HEIGHT IS GREATER OR LESS THAN 95", THE ASSEMBLIES MUST BE ADJUSTED, AS REQUIRED, TO PROVIDE FOR PROPER HOLD DOWN. ONE WAY TO FACILITATE LOADING OPERATIONS IS TO MAKE THE VERTICALS OF THE SIDE FILL GATES 8'-0". AFTER THE INSIDE HEIGHT OF THE CONTAINER IS ESTABLISHED, THE VERTICAL PIECES CAN BE CUT AT THE LOADING SITE.

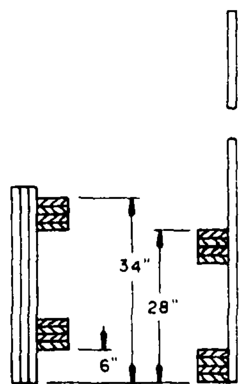


PALLET UNIT

UNIT WEIGHT - 800 POUNDS (APPROX).
CUBE --------- 6.6 CUBIC FEET.

NOTE: THE 31-1/2" UNIT HEIGHT DIMENSION WILL VARY SLIGHTLY, DEPENDING ON THE PROJECTILE BEING SHIPPED; THE PROCEDURES SPECIFIED BY THIS DRAWING ARE APPLICABLE TO ALL 155MM SLP'S WHICH ARE PALLETIZED 8 PER PALLET UNIT. VARIANCE IN UNIT WEIGHT DOES NOT EFFECT THE VALIDITY OF THE DELINEATED PROCEDURES.

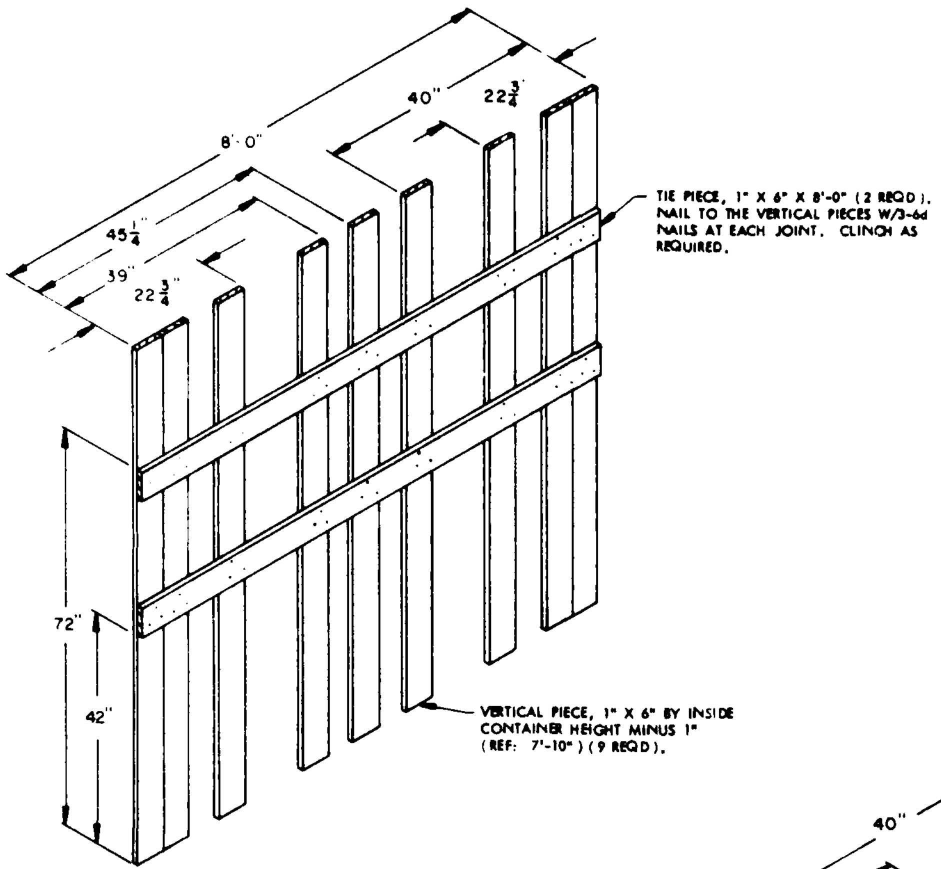




VIEW A

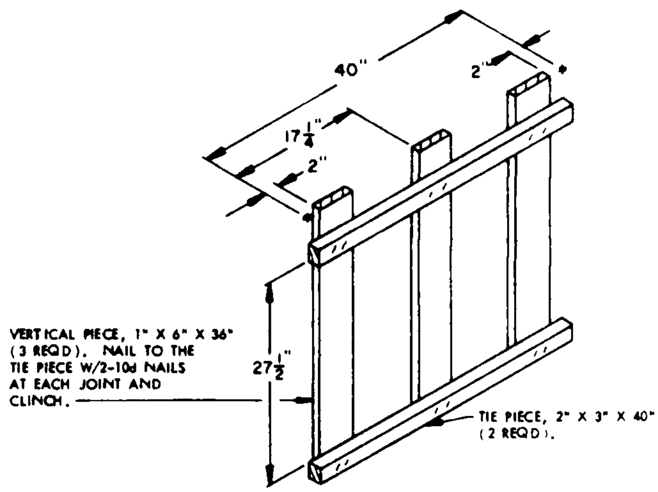
BLOCKING ASSEMBLY

NOTE: THIS ASSEMBLY HAS BEEN DEPICTED FOR THE FORWARD BLOCKING ASSEMBLY. WHEN USED FOR THE REAR BLOCKING ASSEMBLY, IT MUST BE ROTATED 180° PRIOR TO POSITIONING AGAINST THE LOAD. SEE SPECIAL NOTE 1 ABOVE.

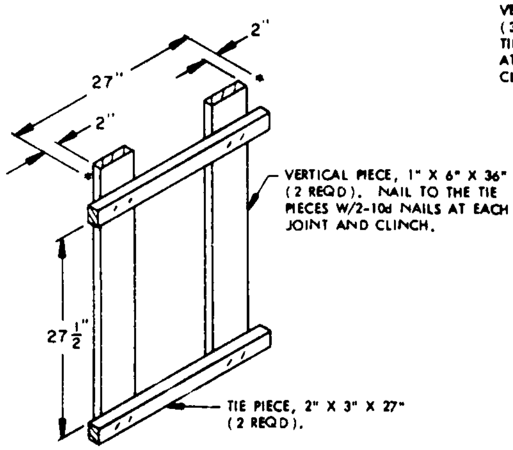


SIDE FILL GATE

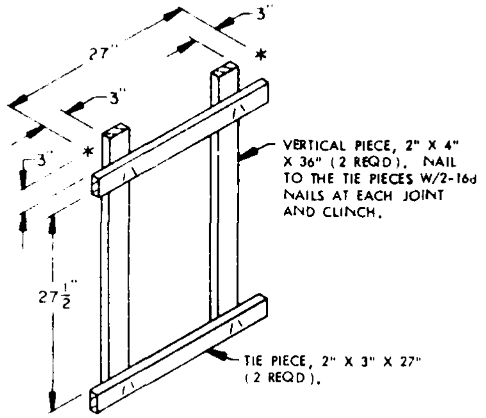
SEE SPECIAL NOTE 2 ON PAGE 4.



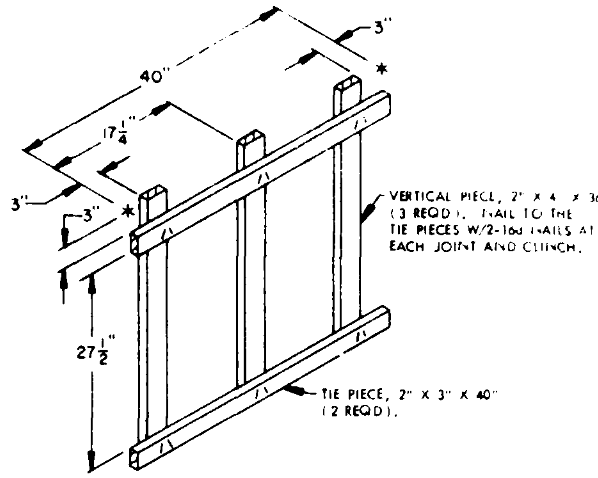
SEPARATOR A



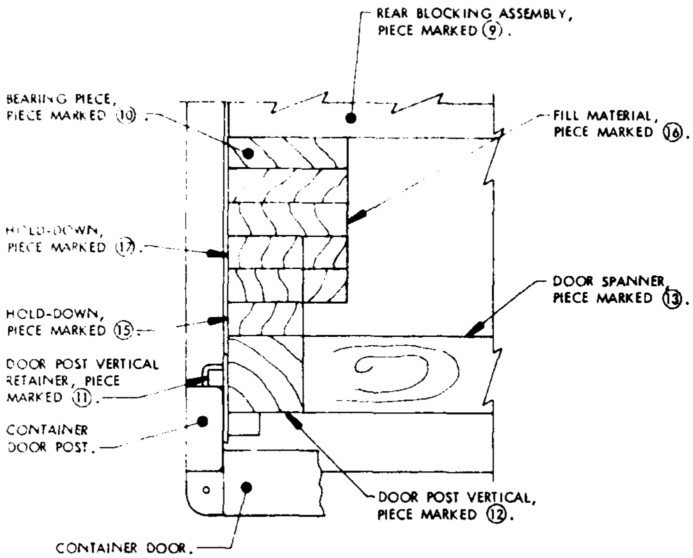
SEPARATOR C



SEPARATOR D

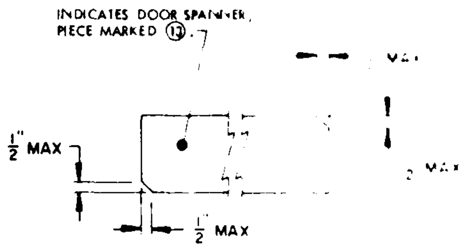


SEPARATOR B



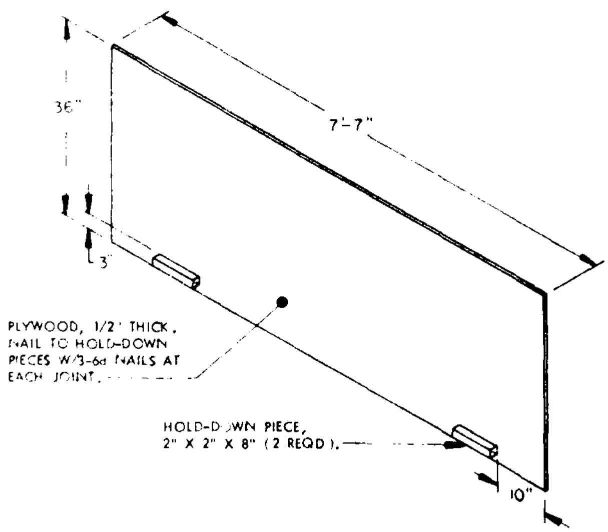
DETAIL A

A PARTIAL PLAN VIEW OF THE LEFT REAR PORTION OF THE CONTAINER IS SHOWN DEPICTING THE PROPER POSITIONING OF THE DOOR POST VERTICAL AND ADJACENT DUNNAGE PIECES.

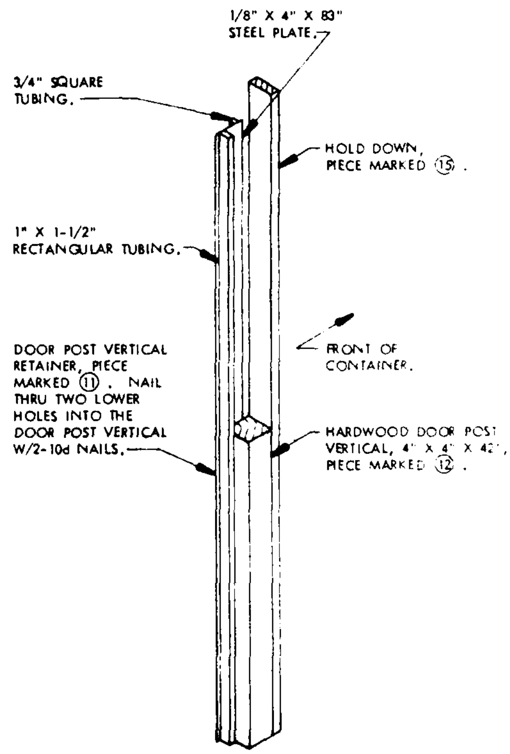


BEVEL CUT

IF DESIRED, EACH END OF A DOOR SPANNER PIECE MAY BE BEVEL CUT AS SHOWN ABOVE TO FACILITATE THE ACHIEVEMENT OF A TIGHT DOOR POST-TO-DOOR-POST FIT.

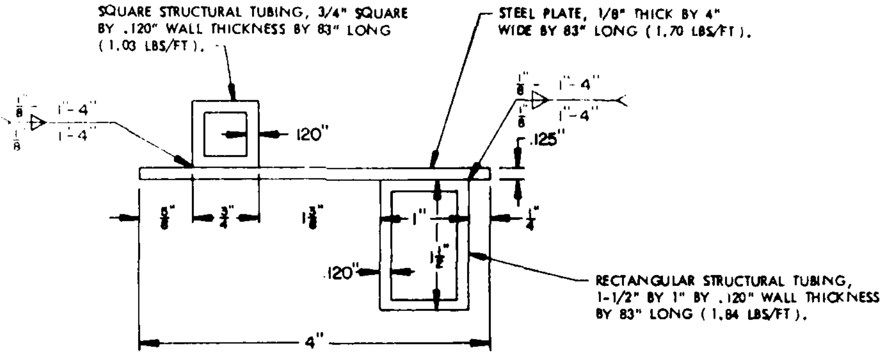


LOAD BEARING GATE

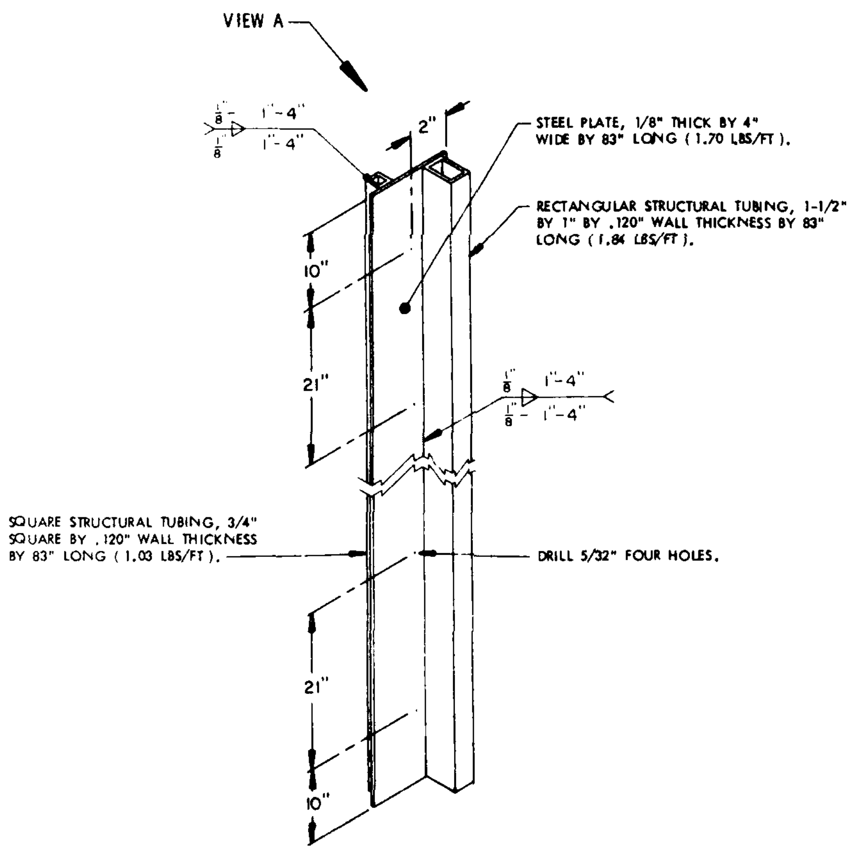


DETAIL B

DOOR SPANNERS, 2" X 4" HOLD DOWN PIECES, DOOR SPANNER SUPPORT PIECE AND FILL MATERIAL HAS BEEN OMITTED FOR CLARITY PURPOSES.



VIEW A



DOOR POST VERTICAL RETAINER

(2 ASSEMBLIES REQD)

APPROVED BY U.S. COAST GUARD	APPROVED BY BUREAU OF EXPLOSIVES
E H Hibson	A. F. Gracamuck
	SUPERVISOR, MILITARY & INTERMODAL SERVICES
DATE 8/2/79	DATE 7/19/79

LOADING AND BRACING WITH WOODEN DUNNAGE IN COMMERCIAL CONTAINERS OF SKIDDED UNITS OF 105MM AMMUNITION PACKED IN WOODEN BOXES (15-BOX SKIDDED UNIT) (METHOD 2)

THE DEPICTED WOODEN DUNNAGE METHOD CAN BE APPLIED TO ANY 8'-6" HIGH COMMERCIAL INTERMODAL 20-FOOT CONTAINER, ALTHOUGH THE DUNNAGE DIMENSIONS HAVE BEEN GIVEN FOR A 92" WIDE BY 95"* HIGH (INSIDE DIMENSIONS) CONTAINER. WHEN THE INSIDE CONTAINER HEIGHT IS LESS THAN 95", THE HEIGHT OF SOME DUNNAGE ASSEMBLIES WILL HAVE TO BE LOWERED BY REMOVING SOME MATERIAL FROM THE TOP OR BOTTOM OF SOME OF THE VERTICAL PIECES.

LOADING AND BRACING SPECIFICATIONS AS DELINEATED HEREIN ARE ADEQUATE FOR SHIPMENTS TO BE MOVED BY ANY SURFACE MODE OF TRANSPORT (MOTOR, RAIL, AND WATER).

REQUIREMENTS CITED WITHIN THE BUREAU OF EXPLOSIVES PAMPHLET 6C APPLY WHEN THE SHIPMENT MOVES BY TRAILER/CONTAINER-ON-FLAT-CAR (T/COFC). SPECIAL T/COFC NOTES FOLLOW.

A. A LOADED CONTAINER MUST BE ON A CHASSIS EQUIPPED WITH TWO BOGIE ASSEMBLIES (TANDEM AXLES) WHEN BEING MOVED IN TOFC SERVICE.

B. THE LOAD LIMIT OF A T/COFC RAIL CAR MUST NOT BE EXCEEDED, NOR WILL A CAR BE LOADED SO THAT THE TRUCK UNDER ONE END OF THE CAR CARRIES MORE THAN ONE-HALF OF THE LOAD LIMIT FOR THAT CAR.

DURING INTRASTATE AND/OR INTERSTATE MOVES BY MOTOR CARRIER, A PROPER CHASSIS/MODIFIED FLAT BED TRAILER MUST BE USED TO PRECLUDE VIOLATION OF ONE OR MORE "WEIGHT LAWS" APPLICABLE TO THE STATE OR STATES INVOLVED.

NOTICE:

DRAWING D-SARAC-4358 ALSO SPECIFIED OUTLOADING PROCEDURES APPLICABLE TO SHIPMENT BY T/COFC OF SKIDDED UNITS OF 105MM AMMUNITION IN COMMERCIAL CONTAINERS. HOWEVER, D-SARAC-4358 DEPICTS INTERIM PROCEDURES FOR ONE TIME USE IN SUPPORT OF A TRIAL SHIPMENT PROGRAM. UNLESS OTHERWISE DIRECTED, ONLY DRAWING D-SARAC-4411 IS APPROVED FOR USE.

* CAUTION: ONLY CONTAINERS WITH A MINIMUM INSIDE HEIGHT DIMENSION OF 93" AND A MINIMUM DOOR OPENING HEIGHT DIMENSION OF 90" CAN BE USED TO ACHIEVE THE TWO-HIGH SKIDDED UNIT LOAD CONFIGURATION DEPICTED HEREIN.

DO NOT SCALE

REVISIONS

APPROVED, U.S. ARMY ARMAMENT MATERIEL READINESS COMMAND

APPROVED BY ORDER OF COMMANDING GENERAL, U.S. ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND (DARCOM)

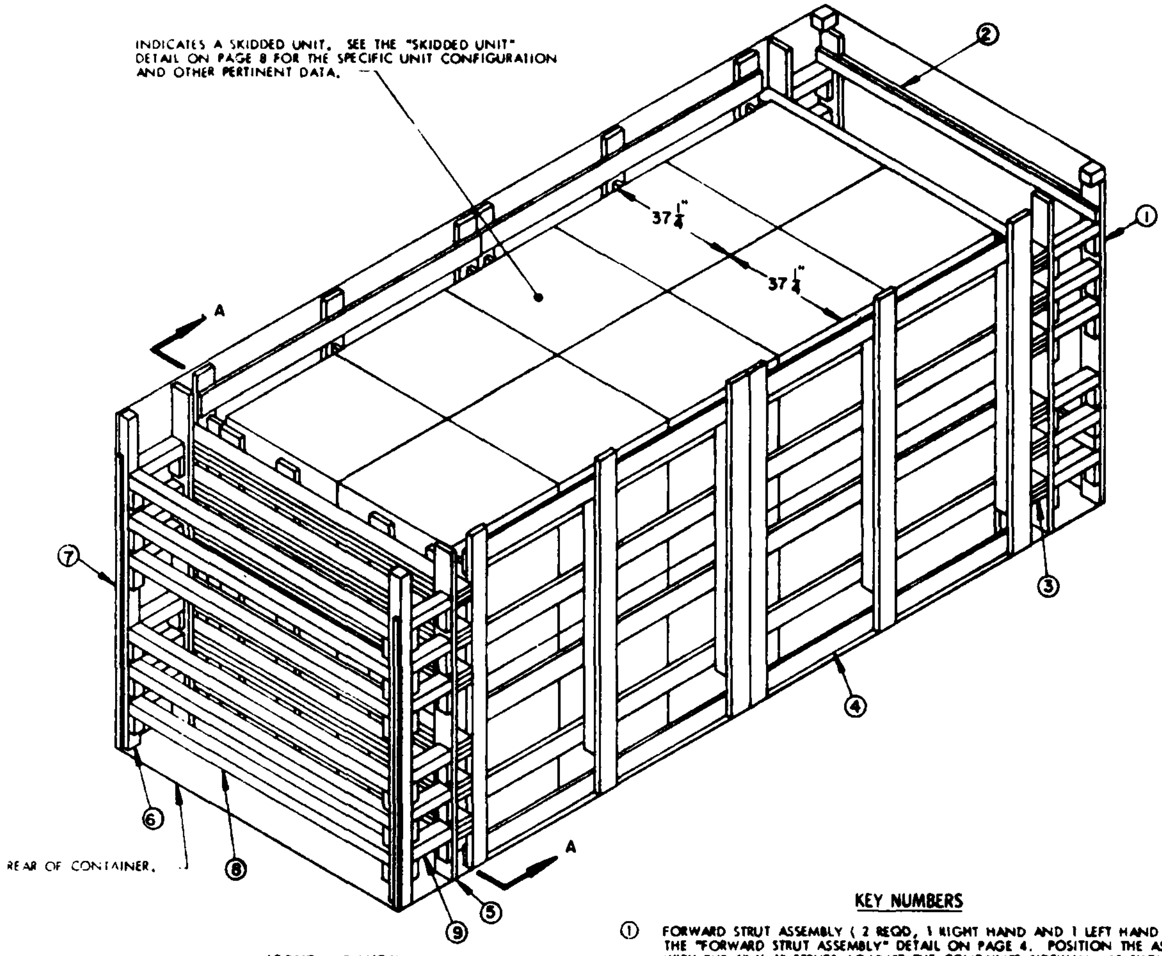
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL

U.S. ARMY DARCOM DRAWING

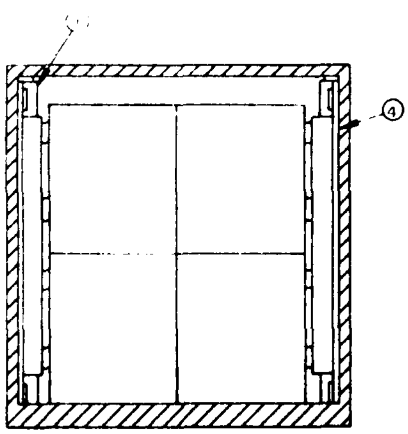
AUGUST 1979

DEF AMMO CEN & SCH DWG NO.

D-SARAC-4411



ISOMETRIC VIEW



SECTION A-A

KEY NUMBERS

1. FORWARD STRUT ASSEMBLY (2 REQD, 1 RIGHT HAND AND 1 LEFT HAND). SEE THE "FORWARD STRUT ASSEMBLY" DETAIL ON PAGE 4. POSITION THE ASSEMBLY WITH THE 4" X 4" STRUTS AGAINST THE CONTAINER SIDEWALL, AS SHOWN ABOVE. AFTER PIECE (3) IS INSTALLED AND CENTERED ON THE WIDTH OF THE CONTAINER, NAIL THROUGH THE REAR BUFFER PIECE OF EACH FORWARD STRUT ASSEMBLY INTO EACH BEAM ASSEMBLY OF PIECE MARKED (3) W/2-12d NAILS AT EACH JOINT.

2. SPREADER ASSEMBLY (2 REQD). SEE THE "SPREADER ASSEMBLY" DETAIL ON PAGE 8. POSITION AS SHOWN, IMMEDIATELY ABOVE THE TOP AND BOTTOM STRUTS AND NAIL TO THE FORWARD STRUT ASSEMBLY W/2-10d NAILS AT EACH JOINT.

3. FORWARD BLOCKING ASSEMBLY (1 REQD). SEE THE "FORWARD BLOCKING ASSEMBLY" DETAIL ON PAGE 4 AND GENERAL NOTE "F" ON PAGE 3.

4. SIDE FILL ASSEMBLY (4 REQD). SEE THE "SIDE FILL ASSEMBLY" DETAIL ON PAGE 5 AND GENERAL NOTE "D" ON PAGE 3.

5. REAR BLOCKING ASSEMBLY (1 REQD). SEE THE "REAR BLOCKING ASSEMBLY" DETAIL ON PAGE 5 AND GENERAL NOTE "F" ON PAGE 3.

6. DOOR POST VERTICAL (2 REQD). SEE THE "DOOR POST VERTICAL" DETAIL AND "DETAIL A" ON PAGE 7.

7. DOOR POST VERTICAL RETAINER (2 REQD). SEE THE "DOOR POST VERTICAL RETAINER" DETAIL ON PAGE 6. NAIL THROUGH THE HOLES INTO THE DOOR POST VERTICAL W/4-10d NAILS.

8. DOOR SPANNER, 4" X 4" MATERIAL, CUT TO A LENGTH THAT WILL PROVIDE FOR A DRIVE FIT (REF: 7'-1-3/8") (6 REQD). TOENAIL TO THE DOOR POST VERTICALS W/2-12d NAILS AT EACH END. SEE THE "BEVEL-CUT" DETAIL ON PAGE 7. AFTER INSTALLING THE BOTTOM AND THE TOP DOOR SPANNERS, THE STRUTS, PIECES MARKED (9), ARE TO BE INSTALLED.

9. STRUT, 4" X 4" BY CUT TO FIT (12 REQD). TOENAIL TO THE BUFFER PIECES OF THE REAR BLOCKING ASSEMBLY AND THE DOOR POST VERTICAL W/2-12d NAILS AT EACH END. SEE THE "BEVEL-CUT" DETAIL ON PAGE 7.

(GENERAL NOTES CONTINUED)

L. RECOMMENDED SEQUENTIAL LOADING PROCEDURES:

1. PREFABRICATE ONE RIGHT HAND AND ONE LEFT HAND FORWARD STRUT ASSEMBLY, TWO SPREADER ASSEMBLIES, ONE FORWARD BLOCKING ASSEMBLY, FOUR SIDE FILL ASSEMBLIES, ONE REAR BLOCKING ASSEMBLY, AND NAIL A DOOR POST VERTICAL RETAINER TO EACH DOOR POST VERTICAL, ONE RIGHT HAND AND ONE LEFT HAND.
2. INSTALL THE TWO FORWARD STRUT ASSEMBLIES (ONE RIGHT HAND AND ONE LEFT HAND) AND TWO SPREADER ASSEMBLIES.
3. INSTALL FORWARD BLOCKING ASSEMBLY.
4. INSTALL TWO SIDE FILL ASSEMBLIES AND LOAD EIGHT SKIDDED UNITS.
5. INSTALL TWO SIDE FILL ASSEMBLIES AND LOAD TWELVE SKIDDED UNITS.
6. INSTALL REAR BLOCKING ASSEMBLY.
7. INSTALL THE TWO DOOR POST VERTICAL ASSEMBLIES (ONE RIGHT HAND AND ONE LEFT HAND).
8. INSTALL TWO DOOR SPANNER PIECES (ONE AT THE LOWEST POSITION AND ONE AT THE UPPERMOST POSITION).
9. INSTALL THE STRUTS BETWEEN THE REAR BLOCKING ASSEMBLY AND THE DOOR POST VERTICALS.
10. INSTALL REMAINING DOOR SPANNER PIECES.

GENERAL NOTES

A. THIS DOCUMENT HAS BEEN PREPARED AND ISSUED IN ACCORDANCE WITH AR 740-1 AND AUGMENTS TM 743-200-1 (CHAPTER 5).

B. THE SPECIFIED OUTLOADING PROCEDURE IS APPLICABLE TO A LOAD OF 15-BOX SKIDDED UNITS OF 105MM AMMUNITION PACKED IN WOODEN BOXES. SUBSEQUENT REFERENCE TO SKIDDED UNIT MEANS THE SKIDDED UNIT WITH AMMUNITION ITEMS. SEE PAGE 8 FOR THE DETAIL OF THE SKIDDED UNIT. CAUTION: REGARDLESS OF THE QUANTITY OF UNITS TO BE SHIPPED, THE "MAXIMUM GROSS WEIGHT" OF 44,800 POUNDS MUST NOT BE EXCEEDED.

C. THE LOAD AS SHOWN IS BASED ON A 4,700 POUND 20' LONG BY 8' WIDE BY 8'-6" HIGH INTERMODAL COMMERCIAL CONTAINER WITH INSIDE DIMENSIONS OF 19'-4" LONG BY 92" WIDE BY 95" HIGH. CAUTION: ONLY CONTAINERS WITH A MINIMUM INSIDE HEIGHT DIMENSION OF 95" CAN BE USED TO ACHIEVE THE TWO-HIGH SKIDDED UNIT LOAD CONFIGURATION DEPICTED HEREIN. THE LOAD IS DESIGNED FOR TRAILER/CONTAINER-ON-FLAT-CAR (T/COFC) SHIPMENT, HOWEVER, THE LOAD AS DESIGNED CAN ALSO BE MOVED BY OTHER SURFACE MODES OF TRANSPORT. NOTICE: OTHER CONTAINERS OF THE SAME DESIGN CONFIGURATION CAN BE USED.

D. WHEN LOADING SKIDDED UNITS, THEY ARE TO BE POSITIONED SO AS TO ACHIEVE A TIGHT LOAD (TIGHT AGAINST THE FORWARD AND SIDE DUNNAGE ASSEMBLIES). ALTHOUGH A TOTAL OF ONE AND ONE-HALF INCHES (1-1/2") OF UNBLOCKED SPACE ACROSS THE WIDTH OF A LOAD BAY IS PERMITTED, LATERAL VOIDS WITHIN THE LOAD ARE TO BE HELD TO A MINIMUM. WHEN THE UNIT WIDTH IS LESS THAN 37-1/4", EXCESSIVE SLACK CAN BE ELIMINATED FROM A LOAD BAY BY LAMINATING ADDITIONAL PIECES OF APPROPRIATE THICKNESS TO THE LOAD BEARING PIECES ON A SIDE FILL ASSEMBLY. NAIL EACH ADDITIONAL PIECE TO THE BEARING PIECE W/1 APPROPRIATELY SIZED NAIL EVERY 12". IF THE UNIT WIDTH IS GREATER THAN 37-1/4" OR THE CONTAINER WIDTH IS LESS THAN 92", IT MAY BE NECESSARY TO USE 2" X 5" MATERIAL IN LIEU OF THE SPECIFIED 2" X 6" SPACER PIECES ON A SIDE FILL ASSEMBLY.

E. DUNNAGE LUMBER SPECIFIED IS OF A NOMINAL SIZE. FOR EXAMPLE, 1" X 6" MATERIAL IS ACTUALLY 3/4" THICK BY 5-1/2" WIDE AND 2" X 6" MATERIAL IS ACTUALLY 1-1/2" THICK BY 5-1/2" WIDE.

F. A STAGGERED NAILING PATTERN WILL BE USED WHEREVER POSSIBLE WHEN NAILS ARE DRIVEN INTO JOINTS OF DUNNAGE ASSEMBLIES OR WHEN LAMINATING DUNNAGE. ADDITIONALLY, THE NAILING PATTERN FOR AN UPPER PIECE OF LAMINATED DUNNAGE WILL BE ADJUSTED AS REQUIRED SO THAT A NAIL FOR THAT PIECE WILL NOT BE DRIVEN THROUGH ONTO OR RIGHT BESIDE A NAIL IN A LOWER PIECE.

G. IN SOME CONTAINERS, SUCH AS SOME ALL STEEL CONTAINERS, THERE IS A SLOT AT THE CORNERS OF THE FORWARD WALL. A PIECE OF DUNNAGE MATERIAL MUST BE LAMINATED TO THE FORWARD BUFFER PIECE ON THE FORWARD STRUT ASSEMBLIES TO PROVIDE A FLAT SURFACE FOR THE 2" X 6" BUFFER PIECES. A PIECE OF 2" X 4", 2" X 3", OR A SPECIAL WIDTH PIECE CUT TO FIT CAN BE USED. THIS FILL PIECE WILL BE NAILED WITH ONE APPROPRIATELY SIZED NAIL EVERY 12". THIS PIECE IS NOT REQUIRED WHEN THE FRONT WALL OF THE CONTAINER IS SMOOTH AND FLAT.

H. CAUTION: DO NOT NAIL DUNNAGE MATERIAL TO THE CONTAINER WALLS OR FLOOR. ALL NAILING WILL BE WITHIN THE DUNNAGE.

J. PORTIONS OF THE CONTAINERS DEPICTED WITHIN THIS DRAWING, SUCH AS ONE OF THE SIDE WALLS, HAVE NOT BEEN SHOWN IN THE LOAD VIEWS FOR CLARITY PURPOSES.

K. TO MAKE LOADING EASIER, TO HELP ACHIEVE A TIGHT LOAD ACROSS A CONTAINER, AND TO PREVENT UNACCEPTABLE DAMAGE TO LADING UNITS WHEN LOADING A CONTAINER, A SLIP-SHEET CAN BE USED EFFECTIVELY AS A "SHOEHORN" TYPE DEVICE. THE SLIP-SHEET WILL PROVIDE A SMOOTH SURFACE THAT WILL PREVENT UNIT STRAPS AND/OR DUNNAGE PIECES FROM INTERLOCKING OR CATCHING ON OTHER PROJECTIONS WHEN LATERALLY ADJACENT LADING UNITS ARE BEING LOADED. A SLIP-SHEET WILL BE USED AFTER ONE-HALF OF A STACK IS LOADED WITH ONE OF ITS SIDES IN TIGHT CONTACT AT ONE SIDE OF THE CONTAINER. THE SLIP-SHEET IS TO BE PLACED AGAINST THE OTHER SIDE OF THE HALF-STACK BEFORE THE LAST HALF OF THE STACK IS LOADED. AFTER A STACK IS COMPLETED, THE SLIP-SHEET IS TO BE REMOVED FOR SUBSEQUENT USE WITH THE NEXT STACK. A SLIP-SHEET OF SUITABLE SIZE CAN BE MADE FROM A SHEET OF 1/8" TEMPERED HARDBOARD (MASONITE) OR FROM A SHEET OF ANY OTHER MATERIAL THAT WILL SATISFY THE REQUIREMENT.

(CONTINUED AT LEFT)

BILL OF MATERIAL

LUMBER	LINEAR FEET	BOARD FEET
1" X 6"	62	31
2" X 4"	59	40
2" X 6"	665	665
4" X 4"	84	112
NAILS	NO. REQD	POUNDS
6d (2")	72	1/2
10d (3")	882	13-3/4
12d (3-1/4")	72	1-1/4
DOOR POST VERTICAL RETAINER --- 2 REQD ------------ 64 LBS		

MATERIAL SPECIFICATIONS

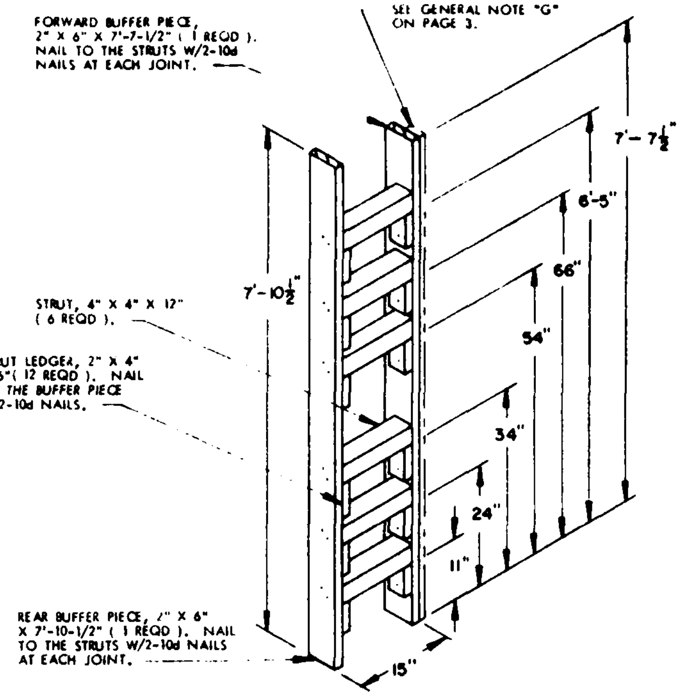
LUMBER --------------------: TM 743-200-1 (DUNNAGE LUMBER) AND FED SPEC MM-L-751.

NAILS --------------------: FED SPEC FF-N-105; COMMON.

STEEL, STRUCTURAL ---------: FED SPEC QQ-S-741; SQUARE STRUCTURAL TUBING AND ROLLED PLATE.

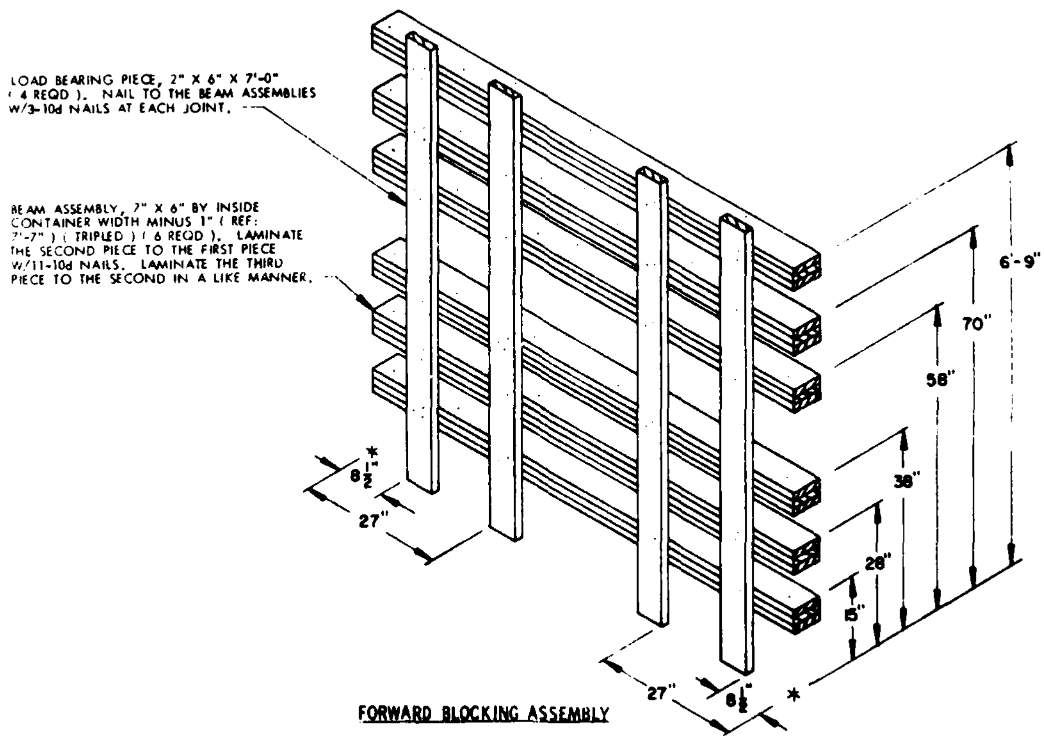
LOAD AS SHOWN

ITEM	QUANTITY	WEIGHT (APPROX)
SKIDDED UNIT	20	33,800 LBS
DUNNAGE		1,776 LBS
CONTAINER		4,700 LBS
TOTAL WEIGHT		40,276 LBS

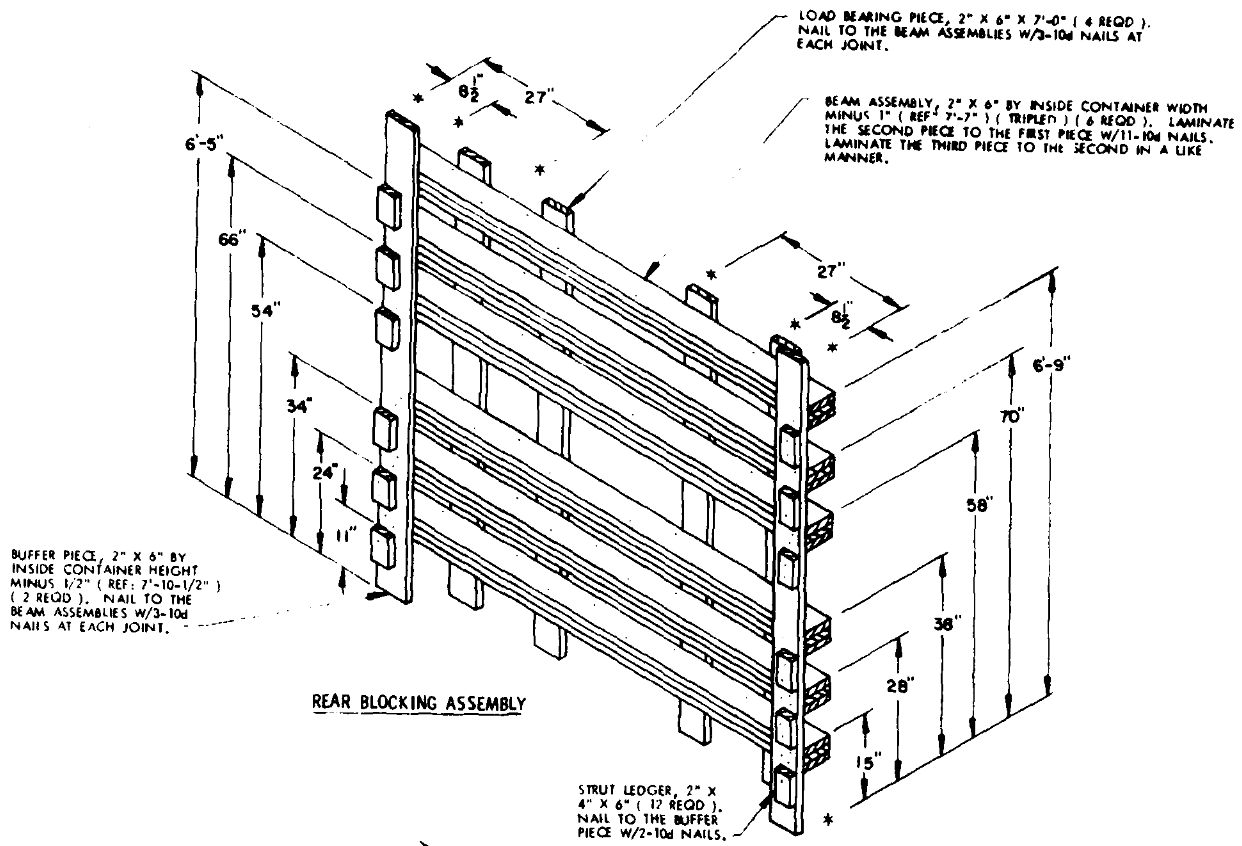


FORWARD STRUT ASSEMBLY

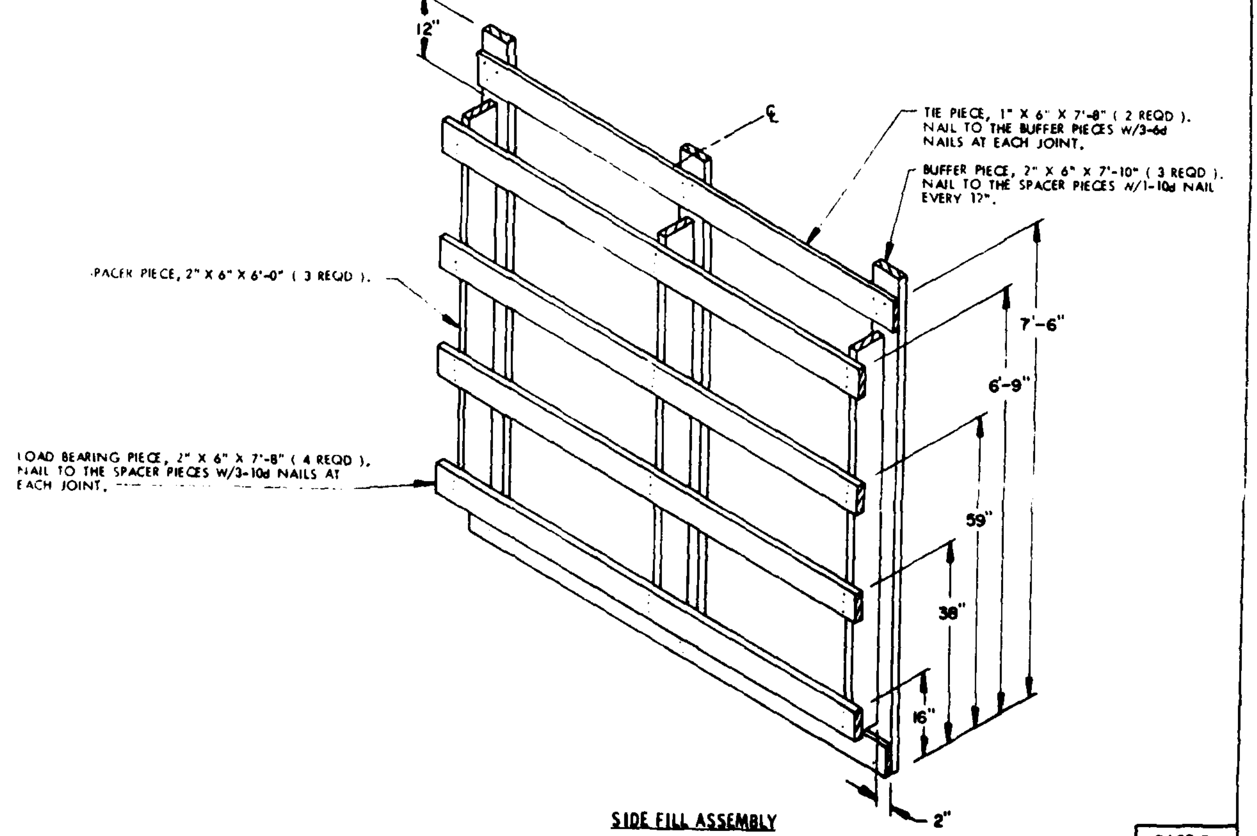
A "RIGHT HAND" FORWARD STRUT ASSEMBLY IS DEPICTED. A "LEFT HAND" ASSEMBLY IS ALSO REQUIRED AND WILL BE THE SAME AS THE ASSEMBLY DEPICTED ABOVE, EXCEPT THE 4" X 4" STRUTS AND STRUT LEDGERS ARE ALIGNED ON THE OPPOSITE SIDE OF THE BUFFER PIECES.



FORWARD BLOCKING ASSEMBLY

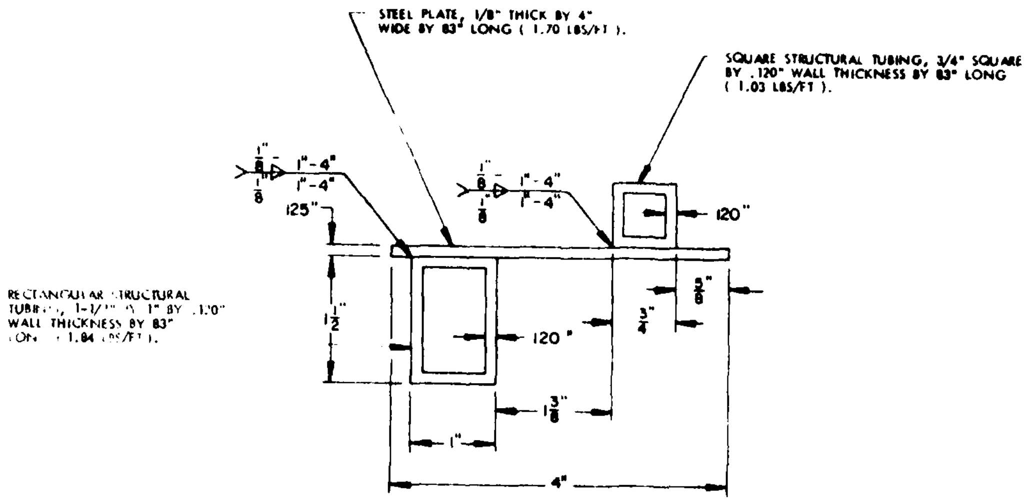


REAR BLOCKING ASSEMBLY

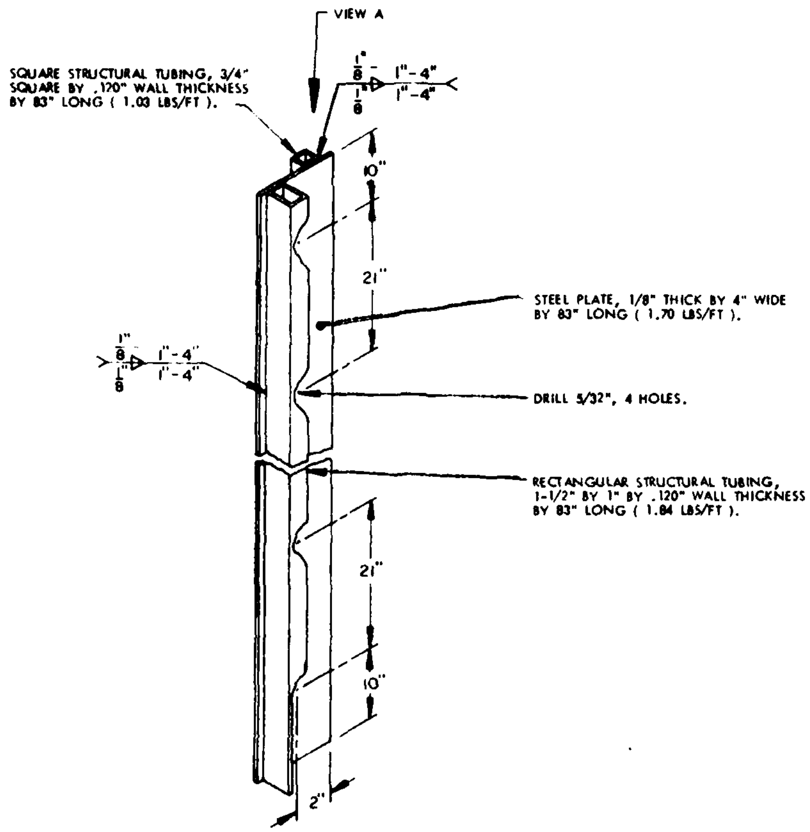


SIDE FILL ASSEMBLY

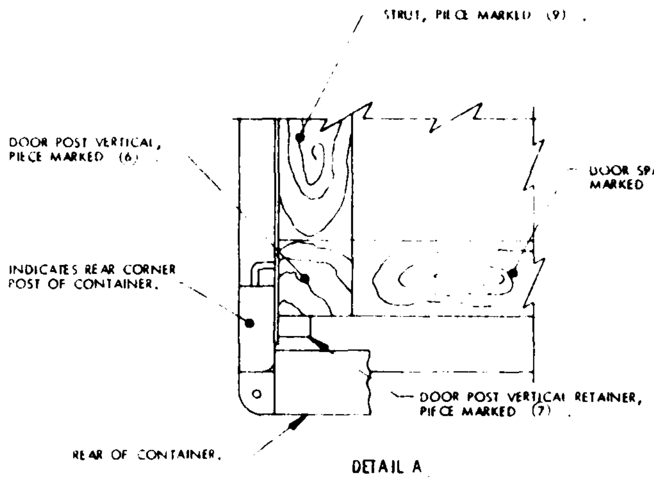
PAGE 5



VIEW A

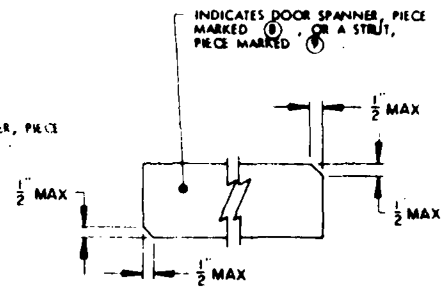


DOOR POST VERTICAL RETAINER



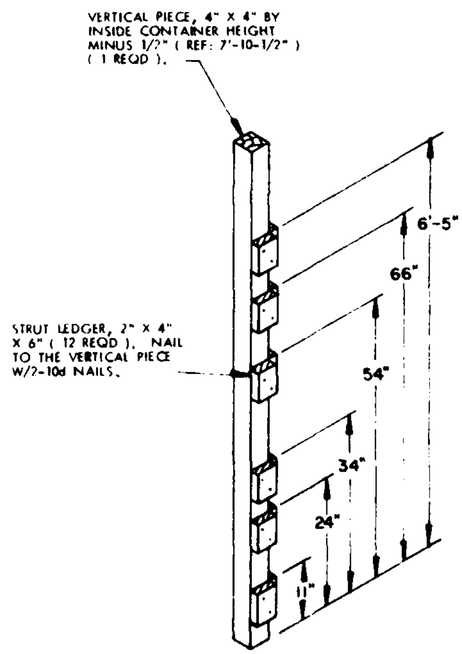
DETAIL A

A PARTIAL PLAN VIEW OF THE LEFT REAR PORTION OF THE CONTAINER IS SHOWN DEPICTING THE PROPER POSITION OF THE DOOR POST VERTICAL AND ADJACENT DUNNAGE PIECES.



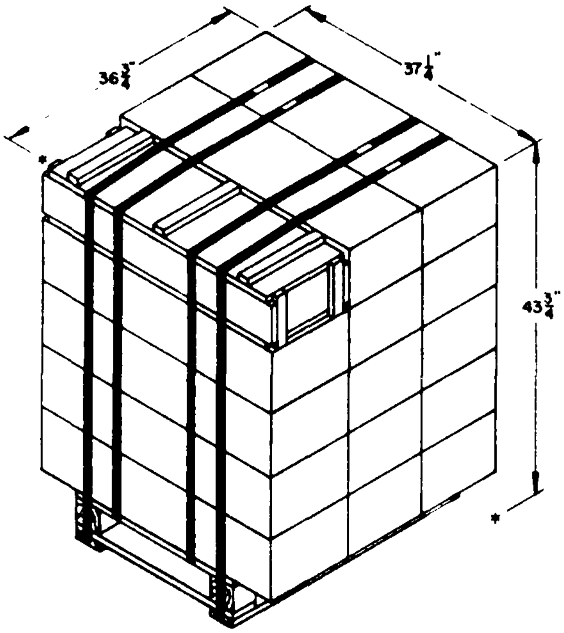
BEVEL-CUT

IF DESIRED, EACH END OF A DOOR SPANNER PIECE OR A STRUT MAY BE BEVEL-CUT AS SHOWN ABOVE TO FACILITATE THE ACHIEVEMENT OF A TIGHT DOOR-POST-TO-DOOR-POST FIT OR TIGHT REAR-OF-LOAD FIT.



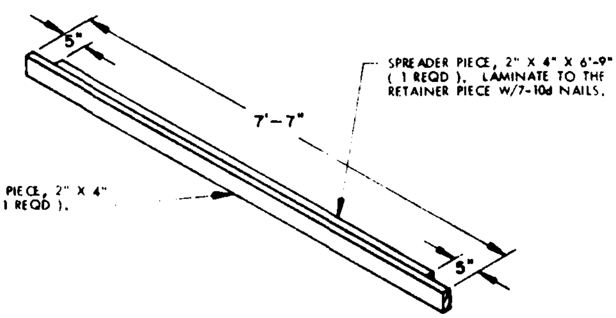
DOOR POST VERTICAL

THE STRUT LEDGERS CAN ONLY BE PRE-NAILED TO THE DOOR POST VERTICAL ON ONE SIDE OF THE CONTAINER FOR THE DOOR SPANNER PIECES. ALSO, THE STRUT LEDGERS FOR THE STRUTS CAN ONLY BE PRE-NAILED TO THE REAR BLOCKING ASSEMBLY OR THE DOOR POST VERTICAL AT THE LOWEST DIMENSION.



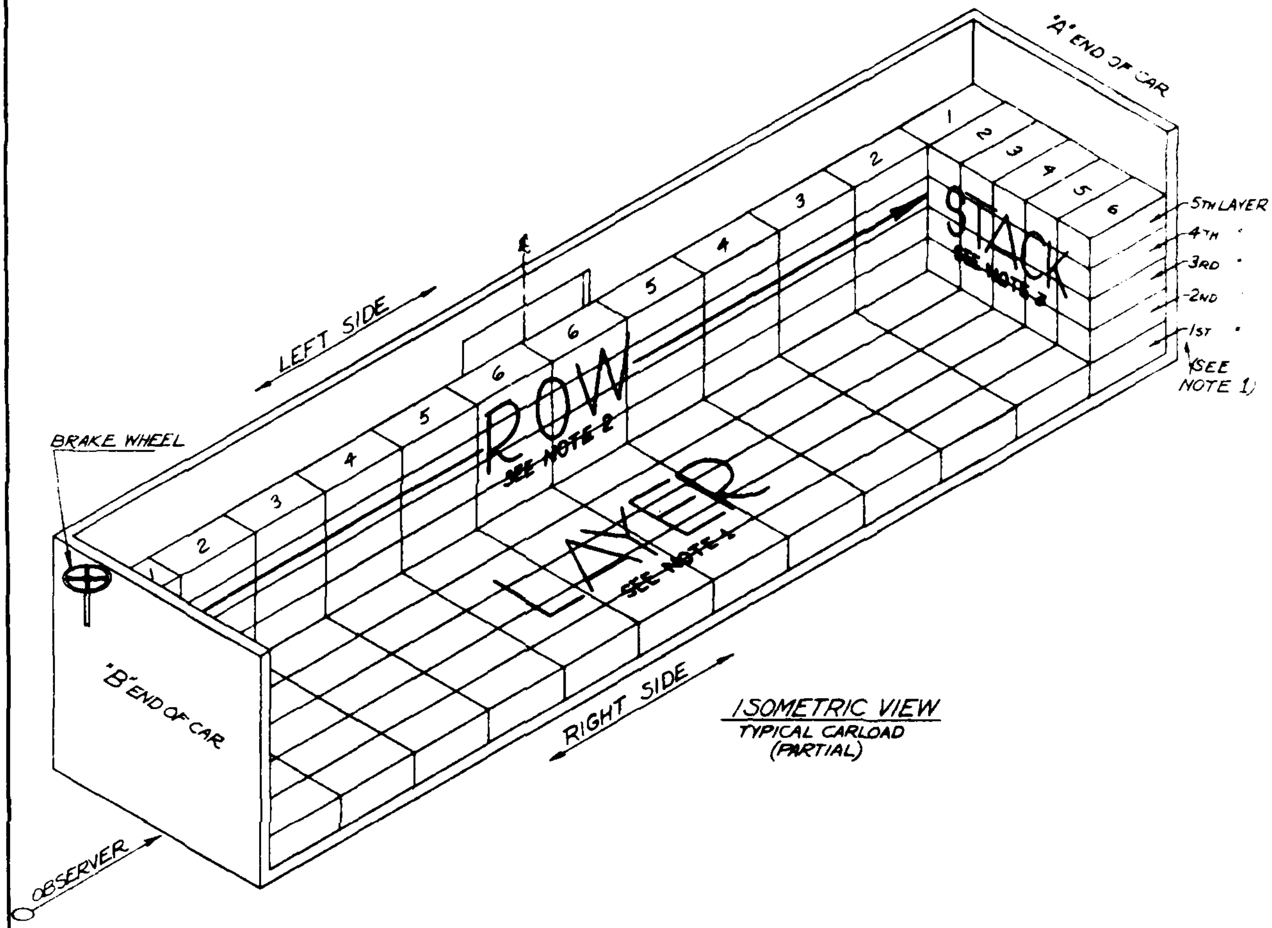
SKIDDED UNIT

UNIT WEIGHT --------------------: 1,690 POUNDS (APPROX).
CUBE ----------------------------: 34.7 CUBIC FEET



SPREADER ASSEMBLY

APPENDIX I



ISOMETRIC VIEW
TYPICAL CARLOAD
(PARTIAL)

GENERAL NOTES

1. LAYERS WITHIN CAR ARE TO BE NUMBERED CONSECUTIVELY FROM CAR FLOOR TO EXTREME HEIGHT
2. ROWS WITHIN CAR ARE NUMBERED FROM LEFT TO RIGHT CONSECUTIVELY
3. STACKS WITHIN CAR ARE TO BE NUMBERED CONSECUTIVELY FROM EACH END (A & B) TO CENTER OF CAR

NOTE:
THE INTENT OF THIS DRAWING IS TO ENABLE CAR INSPECTORS, REPORTING DAMAGED OR IMPROPER SHIPMENT ON DD FORM 6, TO CORRECTLY LOCATE DAMAGE THAT MAY HAVE OCCURRED TO LADING.

RAILROAD TERMINOLOGY FOR BOX CARS TO BE APPLIED IN PREPARING REPORT OF DAMAGED OR IMPROPER SHIPMENT.

DRAFTSMAN CRJ	TRACER	ENGINEER CRJ	SUBMITTED E. C. Peber COL., ORD. CORPS U.S.A.
ENGINEER RAS	CHECKED	ENGINEER	

REVISIONS

EXAMINED James L. Hoctor ORD. CORPS U.S.A.

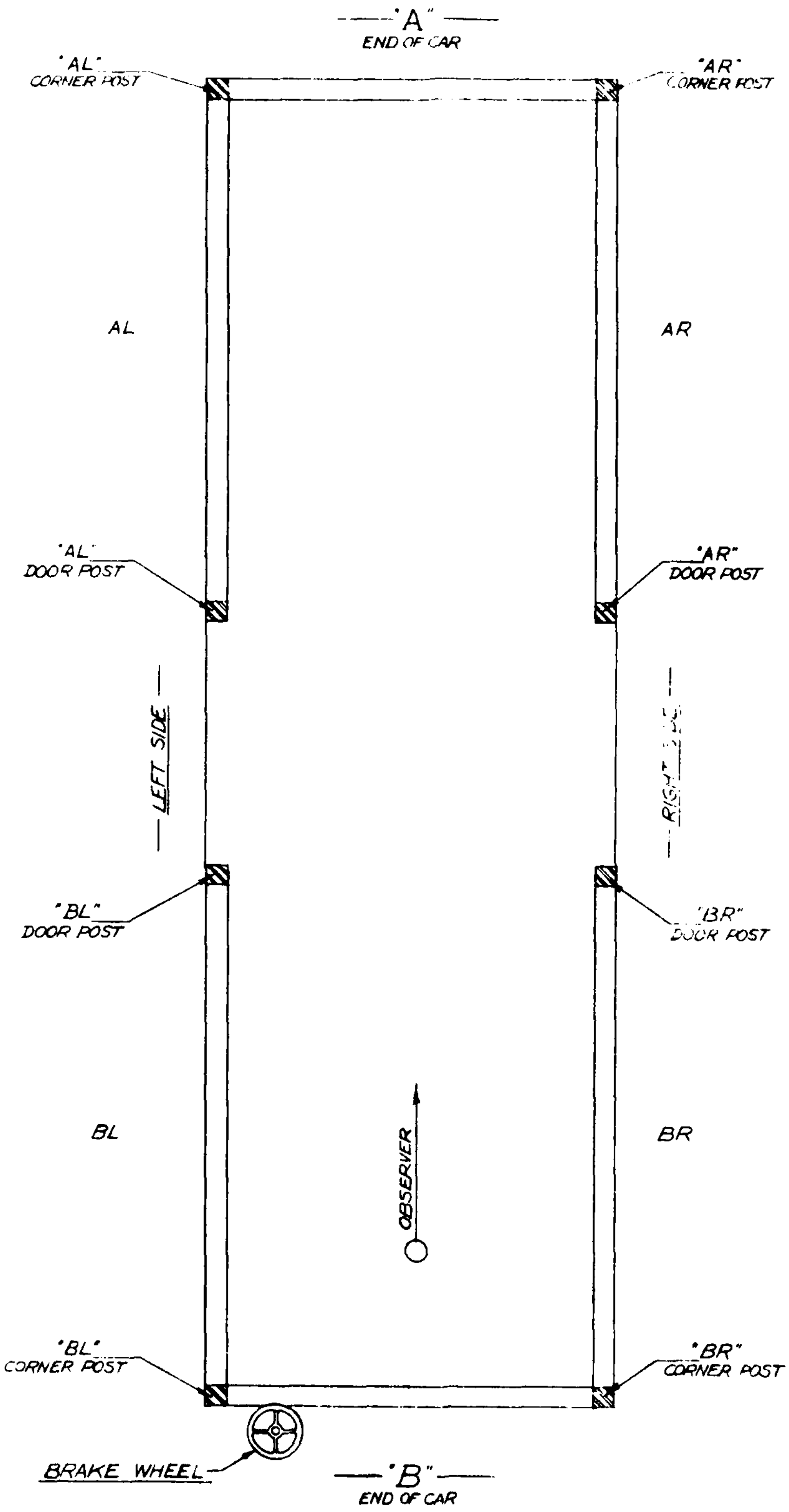
APPROVED BY ORDER OF THE CHIEF OF ORDNANCE

ORDNANCE CORPS, U.S.A.

30 August 1951

CLASS	DIVISION	DRAWING	FILE
19	48	2463	5C88

APPROVED
BUREAU OF EXPLOSIVES
INSPECTOR
DATE



PLAN VIEW OF RAILROAD CAR

APPENDIX J

Typical Skid Plate and ISO Container Capacities

Type of Ammunition	Capacity No. of Pallets Per Skid Plate	Capacity No. of Pallets Per Container	Skid Plate % Capacity Skid Plate ÷ by Container
8" SLP's	26	27	96
155 mm	39	42	93
105 mm	13	20	65

APPENDIX K

Typical Outloading Operation @ Savanna Army Depot (8-hr. Shift

Milvans / Commercial-Container

Commodity Item	Particular Cycle	Eq'mt MHE Req'd	Unit load carrying Capacity (Quantity)	Total Manpower Nº Operators (per shift)
8" SLP's	Igloo (unstuffing Igloo)	(1) Elect, solid tired Forklift (1) GED, pneumatic tired Forklift (1) Flat-bed Trailer	(2) Pallets per lift (2) Pallets per lift 15-20 Pallets per Trailer (12 Ton load cap.)	(2) Forklift Operato (1) Tractor/Trailer Driver at Igloo
	Intra Depot Transport	(2) Flat-bed Trailers (In Transit)	15-20 Pallets per Trailer	(2) Tractor/Trailer Drivers (1) being off-loade (1) in-transit
	Container Stuffing Area	(2) Low Boom Solid Tired GED, Forklifts (Works 4-Milvans) (1) Platform Forklift	→ (1) Pallet per lift, per [illegible] → (2) Pallets per lift	(3) Forklift Operat (8) Block & Brace (Work 4-Milvans)
	Container Handling [Positioning Full Containers onto Railcar]	(1) 50K, Frontend Loader	(1) Fully Loaded 20'-0" Container, per lift.	(1) Forklift Operato (1) Spotter, (Railcar)

Total Outloading Time 7-8 Containers Per 8-hr Shift

Respective Cycling Time (Average)

Based on 8" Separate Loading Projectiles, and a total outloading capability of between 7 and 8 containers per 8-hr shift (6-hours operator time)

27 Pallets per Container.

Total No. Pallets Transferred = 189 to 216

Outloading Location	Particular Pacing Operation & Location	Resultant transfer rate Pallets / hr.
Igloo Area	(1) forklift transports 2 Pallets / lift	∴ to move 189 to 216 pallets in 6 hours, requires 31 to 36 pallets be moved each hour or approximately 3 to 4 minutes to complete one roundtrip
Intra depot	(1) Trailer can transport 18 pallets (12 ton max. load)	∴ to transport 189 to 216 pallets in 6 hours requires between 11 and 12 round trips, or (4) round trips per trailer (based on total of (3) trailers working) or each trailer takes approx. 1½ hrs to complete one round trip.
Container Stuffing Area	(1) forklift (Low Boom) transports (1) pallet per lift. Therefore Based on (2) forklifts working together.	∴ to transport 189 to 216 pallets in 6 hour, requires between 31 & 36 pallets be moved each hour or with (2) forklifts working, takes between 15 and 18 trips each hour per each forklift or 3 to 4 min. per trip

Therefore, the longest time interval in the system is the Intra depot time, which requires $1\frac{1}{2}$ hrs to complete one round trip. (Based on using total No. of (3) flatbed trailers)

The next longest time interval is the same for both the cycle time required to outload the ammunition at the igloo storage site, and to outload ammunition into containers at the container stuffing area, which is 3 to 4 minutes per forklift round trip.

19 Sept 80

Sierra Army Depot

Normal Break-down:

(4) Transport Straddle lift/Tractor Units

work (8) Skidded Base

Transport Plat forms

Cycle Time, Approximately ______

Sierra Army Depot

Blankenship
(7) 830-9515

Straddle Transporter

Transport Plat-form (Skid Base)

Normal Outload Capacity

		Pallets/Skid Base	Total Weight
8" SLP's	—	26	
155mm SLP's (800 lbs/pallet)	—	39 "	31,668 lbs
105mm (1690 lbs/Skid Unit)	—	13 "	

turn around time = 20 min.
2 people

Present Outloading Rate

155mm SLP's (800 lbs/pallet)

(164) per Box car

(8) Box cars per 8 hr. shift

APPENDIX L

AMMUNITION CONTAINER 50K LBS HANDLING EQUIPMENT
(AS OF 1 APR 1980)

INSTALLATION	HYSTER 50K FRT LOADER	LANCER-BOSS 50K SIDE-LOADER	CATERPILLAR R/T 50K FRT LOADED *
ANNISTON	1		1
HAWTHORNE		2	1
LETTERKENNY	2		1
LEXINGTON-BLUE GRASS	1		1
McALESTER			1
NAVAJO		1	1
PUEBLO	1		
RED RIVER	1		1
SAVANNA	1	1	
SENECA	1		1
SIERRA		1	1
TOOELE	1		1
UMATILLA	1		1
FT. WINGATE		1	1

* PLANNED DISTRIBUTION

ANALYSIS OF DESCOM DEPOT RESPONSES

	Anniston	Letterkenny	Lexington Blue Grass	Navajo	Pueblo	Red River	Savanna	Seneca	Sierra	Tooele	Umatilla	Ft. Wingate	TOTAL DESCOM
Container Handling													
nt Loader	1 @ 50	2 @ 50	1 @ 50		1 @ 50	1 @ 50	1 @ 50	1 @ 50		1 @ 50	1 @ 50		
hile Crane Bar	1 @ 15	2 @ 15	1 @ 15		1 @ 15	1 @ 15	1 @ 15	1 @ 15	1 @ 15	1 @ 15	1 @ 15	1 @ 15	
TOTAL (containers/shift)	65	130	65	-0-	65	65	65	65	15	65	65	15	
Stuffing Capability													
Low Mast Forklift	50 @ 12	18 @ 12	7 @ 12	7 @ 12	-0-	11 @ 12	5 @ 12	8 @ 12	4 @ 12	15 @ 12	7 @ 12	7 @ 12	
TOTAL (containers/shift)	600	216	84	84	-0-	132	60	96	48	180	84	84	
Intradepot Transfer*													
Straddle Trailer Equivalents	8 @ 16	8-1/3 @ 16	10 @ 16	2 @ 16	3-2/3 @ 16	4-1/3 @ 16	2 @ 16	1-2/3 @ 16	7 @ 16	12-2/3 @ 16	5-2/3 @ 16	1-2/3 @ 16	
TOTAL (containers/shift)	128	133	160	32	58	69	32	27	37	203	90	27	
Theoretical Capability (containers/shift)	65	128	65	-0-	-0-	65	32	27	15	65	65	15	542
Reported Capability (containers/shift) (8 hr shift)	24	50	80	7.5	30	44	46	48	21	80	28	37	495.5

** SIAD stated they would use MILVAN's on chassis at the magazine. They stated an availability of 2 tractors. Based on a 20.5 minute cycle time and 384 minutes (60%) of time useable, SIAD could accomplish 37 containers/shift. However, container lift capability is the limiting factor.

* Limiting factor is the quantity of tractors and straddle trailers, vans, and flatbeds. 1 Straddle trailer has capability of 16 containers per shift. Equipment expressed at straddle trailer equivalents. 3 tractors with vans, flatbeds equivalent to 1 straddle trailer.

Incl 2

	Anniston	Letterkenny	Blue Grass	Navajo	Pueblo	Red River	Savanna	Seneca	Sierra	Tooele	Umatilla	Ft. Wingate
Container Handling Equipment												
50,000 LB Frontloader	1	2	1	N/A	1	1	1	1		1	1	None
20 Ft Spreader Bar	1	3	2	1	1	1	1	1	1			
Mobile Crane	1	2	2 (10 T)	1 (10 T)	1	2	2	[illegible]	1	4	2	1 (20 T)
Low Mast Forklift (83" mast)	35-2,000 lb (68") 5-4,000 lb (68") 5-4,000 lb (82") 5-6,000 lb (82")	18	7	7	None	11	5	3-4,000 lb FT Gas 1-6,000 lb FT Gas 4-4,000 lb Lowlift Gas	6	15	7	7
Electric Forklift (4,000/6,000 lb)		10	15	7" of low mast	6	11	9	11-4,000 lb 2-6,000 lb	6	21	12-2,000 lb 18-4,000 lb 6-6,000 lb	8-4,000 lb 1-6,000 lb
Gas Forklift (4,000/6,000 lb)	6-2,000 lb (67") 1-4,000 lb (67") 7-4,000 lb (82")	15	24	5 2-Rough Terrain	2	5-4,000 lb	8	4-4,000 lb Highlift		75	11-2000 lb 18-4000 lb 13-6000 lb 5-10,000 lb	1-4,000 lb 3-6,000 lb
Straddle Trailers	None	7	7	1	2	2	None		7	4	5	None
Vans	31	10	16	4	None & Rel-12	10	13	11		15	6	5
Flatbeds	5	4	3					2		15	2	Lowboy-1 Fastback-1
Tractors												
3 Ton	21	10	16	3	7	7	5	4	2	15	6	5
10 Ton	3	1		1	None	2	1	1		18	1	None
MCA Projects	Loading Platform	Truck Inspection Facilities-FY79 Blocking & Bracing Facility FY81 LTL/LCL Facility FY83	None	3-100'X300' Container Loading Yard 4-Trailer 2-Straddle Trailer 10-MILVAN Carriage 5-5 Ton Tractor 4-Truck Battery 4-Battery Charger 2-Frontloader	None	2-Container Loading Docks FY81 1-Loading Dock FY81 Modification Igloo doors/apron-FY81	Igloo Alterations FY80-152 Igloos $370,000	None Long Range Igloo Ramps		None	Modification of 252 igloo Aprons $400,000 Improvement of Road Net $495,000	Container Loading Yard 1980
	FY84-Igloo Apron Expansion 61,000 sq.ft. 1,768,000	FY81-Ammunition Truck Blocking Facility $318,000			FY81-Igloo Apron Expansion 750 m $3,125,000	FY80-Modification Igloo door & apron 50 = $849,000 FY81-82-83-84 FY81-move to FY00 Containerization Loading Yard 2 @ 163 = $326,000 FY81-Ground Level Cardoor Loading Dock with Piggyback Capability $209,000		FY82-Construct Igloo Ramps-288 Igloos $432,000	FY82-Cover Team Tracks 358,000			
Container Shipping Capability												
1 Shift/8 hours	4 crews/6 cntr each = 24	50 Note: Cntr Outloading Facilities Available for 80	80	7.5		44	46			80		Has had no experience
1 Shift/12 hours 1 Shift/Extended	4 crews/9 cntr each = 36							48				32/Shift on Truck Trailer 5/Shift on Railcar (extended shift)
2 Shift		Above short fall in MHE & Storage Location					93					
2 Shift/10 hours					60							
3 Shift										184		
		MCA Ammo Truck Blocking facility would increase truck container shipment 10%		With MCA & equipment, would increase capability 3 times = 22 Container/8 hour shift.								

LMED

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